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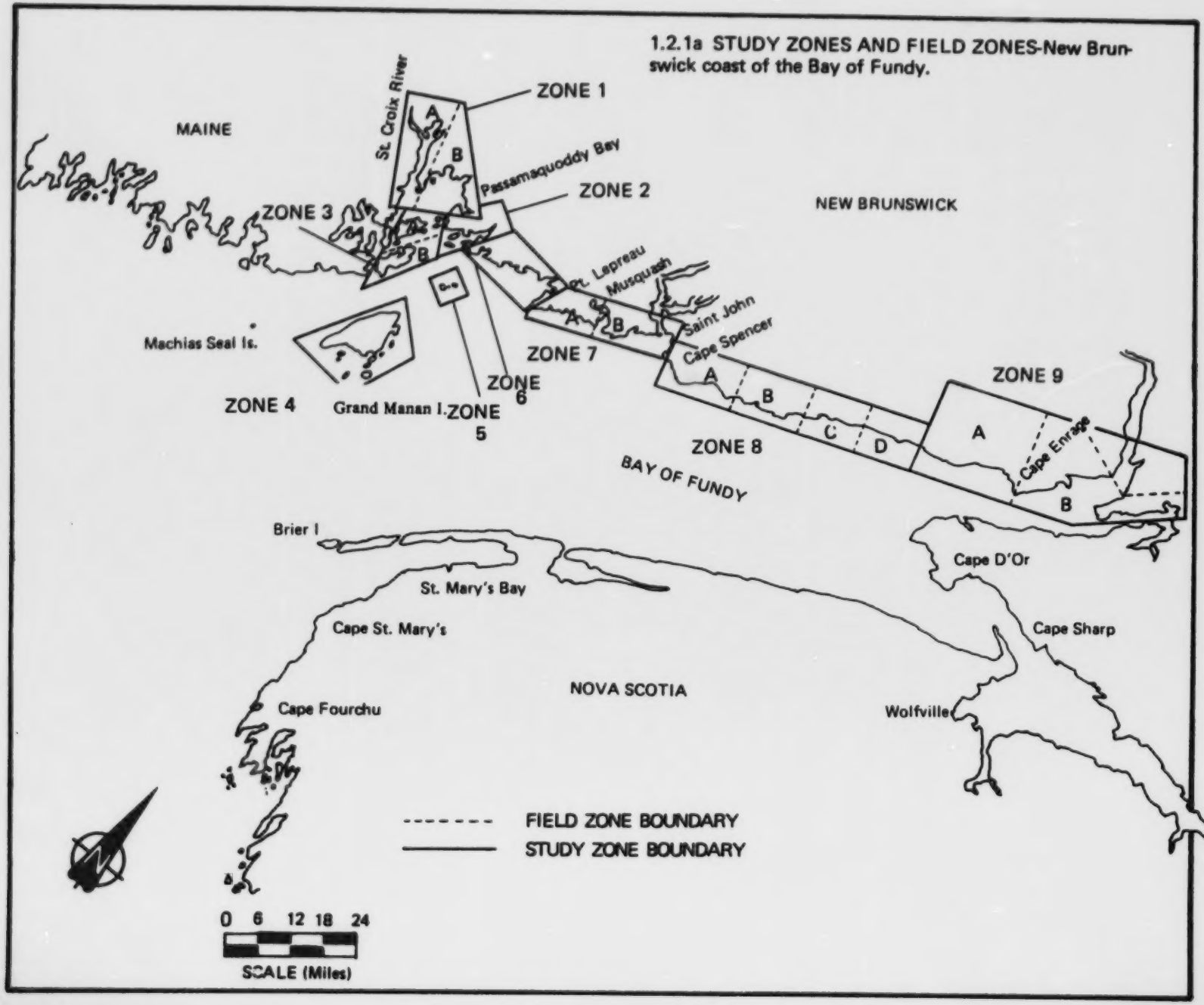
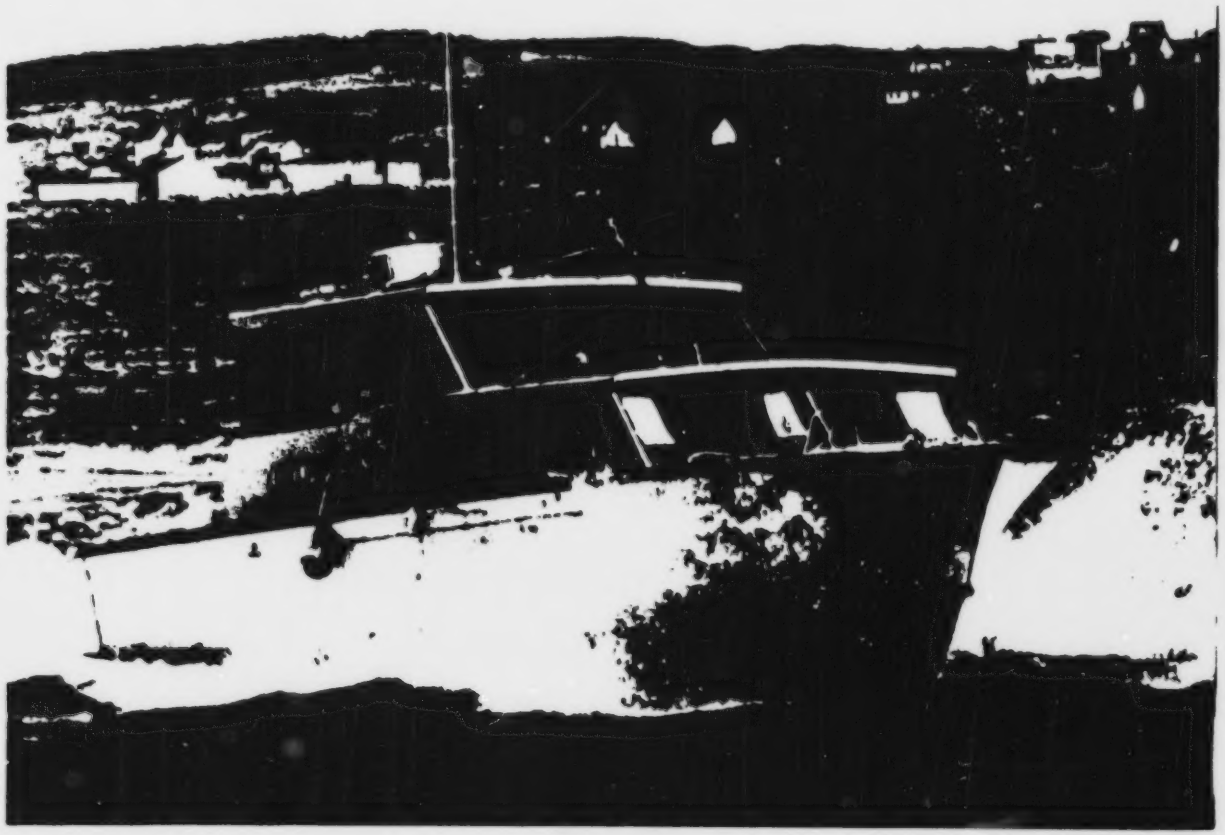
All drawings of plants and animals in this report are copy-written. A. MacKay, 1973.


1.2.1a STUDY ZONES AND FIELD ZONES-New Brunswick coast of the Bay of Fundy.
MAINE
St. Croix River
ZONE 1
A
B
Passamaquoddy Bay
ZONE 2
NEW BRUNSWICK
ZONE 3
Lepreau
Musquash
Saint John
Cape Spencer
Machias Seal Is.
ZONE 7
ZONE 9
ZONE 4
Grand Manan I.
ZONE 6
ZONE 5
ZONE 8
C
D
Cape Enrage
BAY OF FUNDY
Brier I
Cape D'Or
St. Mary's Bay
Cape St. Mary's
Cape Sharp
NOVA SCOTIA
Cape Fourchu
Wolfville
FIELD ZONE BOUNDARY
STUDY ZONE BOUNDARY
0 6 12 18 24
SCALE (Miles)



2.1.1 THE DELPHINUS, MRA'S SURVEY VESSEL

1. INTRODUCTION and OBJECTIVES

1.1. INTRODUCTION

Advances in technology during this century, coupled with world population increases and changes in socio-economic patterns, have had a profound impact on our traditional way of life. Heavy industry has developed to an unprecedented level and has spread from the original centres of development to new areas; including coastal sites which have historically drawn their sustenance from resource-based industries such as fishing. As a result, resource-based industries are increasingly in conflict with heavy industry since they can be, and have been, eliminated by heavy pollution. In addition, technological advances in fishing methods and resultant overharvesting have resulted in greatly reduced stocks of many fish species. At the same time, and largely as a result of these developments, man is currently looking at new ways to grow and harvest marine food species by controlled methods in the ancient, but new, science of aquaculture. Also, applied science is looking to previously unutilized food, drugs, additives and so on.

Unfortunately, while we have advanced technologically at a tremendous rate, we have, with the possible exception of traditionally valuable food species, accumulated very little useful information on our marine resources. There are many reasons for this lack of basic knowledge. Early field studies were usually academic in nature and little regard was paid to population size and sustainable yields, particularly for non-commercial species. In addition, advances in technology also influenced the biological fields and it became unfashionable to be involved in basic field biology. With the popularization of "Ecology" and the general availability of the Self-Contained Underwater Breathing Apparatus (SCUBA) this has all changed and we are now in a position to collect basic field data on most marine organisms. It is vital that we do so as rapidly as possible in order for us to make intelligent decisions regarding:

1. the location and extent of industrial development which should be allowed along our coast in relation to existing or potential resource-based industries;
2. the suitability of potentially marketable species for fisheries utilization;
3. the suitability of presently non-commercial species to potential utilization and the importance of these species to the maintenance of commercial species;
4. the monitoring of water quality with a view to preventing or stopping the introduction of harmful pollutants which may permanently damage our water systems or render our fisheries impotent;
5. the physical suitability of certain areas and species to the development of intensive fish farming and aquaculture; and
6. the maintenance of an environment which is suitable for high quality human existence.

The Research and Development Branch, New Brunswick Department of Fisheries has recognized these needs and has contracted Marine Research Associates Ltd., Lord's Cove, Deer Island, N.B. to undertake a survey of the marine resources of the New Brunswick coast of the Bay of Fundy. This is one of a series of volumes giving our findings. It is hoped that this survey will eventually include the entire coast and will cover intertidal, shallow-water, deepwater, and pelagic organisms and that the information obtained will serve as the foundation for intelligent management and utilization of the marine resources of the Bay of Fundy.

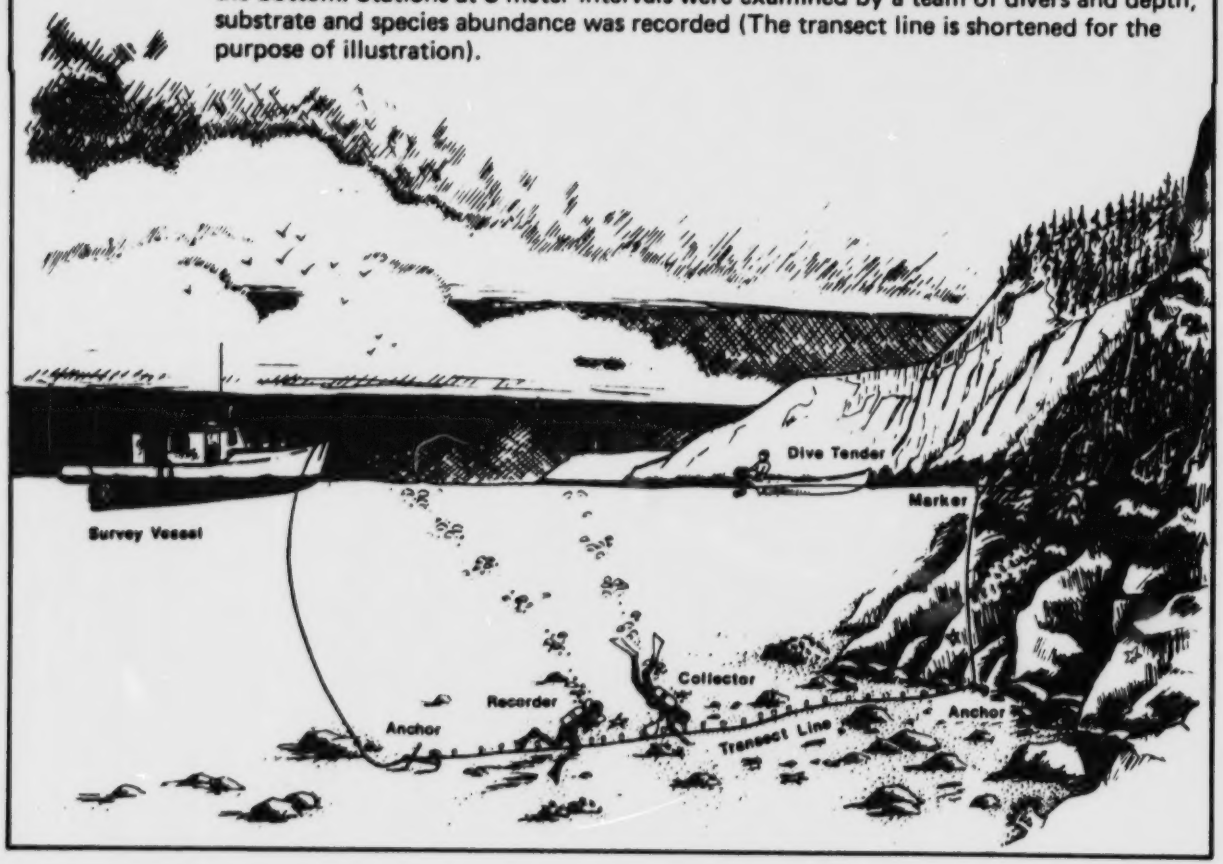
1.2. OBJECTIVES

The purpose of this study was to catalogue, as fully as possible, the shallow-water marine resources of the Bay of Fundy coast. The coast was divided into zones, each encompassing a specific geographical area of a size where field work could be completed during a reasonable period of time. Zone locations and extents are shown in Figure 1.2.1.

Specifically, the objectives of this study were:

1. to compile qualitative and quantitative data on the composition and distribution of all marine species encountered in each zone as well as meteorological, geological, oceanographic and topographic data,
2. to collect data on salinity, temperature, conductivity and pH throughout the study area,
3. to collect information on the commercial fisheries of each zone including species fished and the fishing gear, grounds, landed weight and value of each species,
4. to collect information on the abundance and exploitation rates of exploited marine resources, other than those utilized by the commercial fishery, and
5. to collect information on all sources and types of pollution, the approximate discharge rate from each source, and the distribution and impact of each pollutant.

2.1.2 SUBTIDAL SURVEY TECHNIQUE. A 100 meter Transect line was laid across the bottom. Stations at 3 meter intervals were examined by a team of divers and depth, substrate and species abundance was recorded (The transect line is shortened for the purpose of illustration).



2. METHODS

Site data have been compiled by Marine Research Associates Ltd. over a continuous field period, both winter and summer, beginning in 1964. Numerous collecting methods have been used including:shore collection and observation, dip nets, plankton tows, minnow seines, bottom drags, and diving. Some sites have been visited hundreds of times by our field staff and have been subjected to close observation. Others have been visited specifically for examination in terms of this study.

Location of sites for shore examination, spot dives or transects was considered to be critical. Since the number of study sites were limited by time and cost, it was essential that these sites be representative of the zone and provide reasonable coverage. Choice of transect sites, for detailed quantitative data, were not made until spot dives and shore examinations were completed. As a result, it was possible to choose sites for detailed examination on the basis of known information and to obtain quantitative data which was more representative of the zone than would be true with randomly selected sites.

In general, spot dives and shore examinations were made at regular intervals along the coast. In many cases, sites were examined qualitatively. However, where specific organisms were of interest, or where the site was particularly interesting, intertidal and subtidal transects were run as outlined below and water quality data have been collected as detailed elsewhere in this volume.

Data on shore sites and some dive sites were collected by teams traveling to the site by automobile. Information was collected by careful examination of the organisms occurring in the selected area and, where necessary, dip nets or minnow seines were used to sample tide pools or shallow water areas.

Until 1977, most field data were collected by teams of divers working from an outboard powered skiff or the survey vessel "Donna G". The "Delphinus" (Figure 2.1.1) was acquired in 1977 and data for the 1978-79 season were collected from this vessel.

All divers were equipped with 3/8 inch "wet" suits and accessories or constant volume dry suits (UNISUITS). The Unisuits proved to be invaluable during winter operations and allowed our divers to operate in extremely cold waters with much the same comfort as in summer. Single 72 cu. ft. air cylinders with single hose Poseidon regulators were used on all dives. Recordings of depth were taken from Aqua-Lung underwater depth gauges checked against measured depths. Underwater observations were recorded in pencil on Appleton Underwater "Ascot" paper.

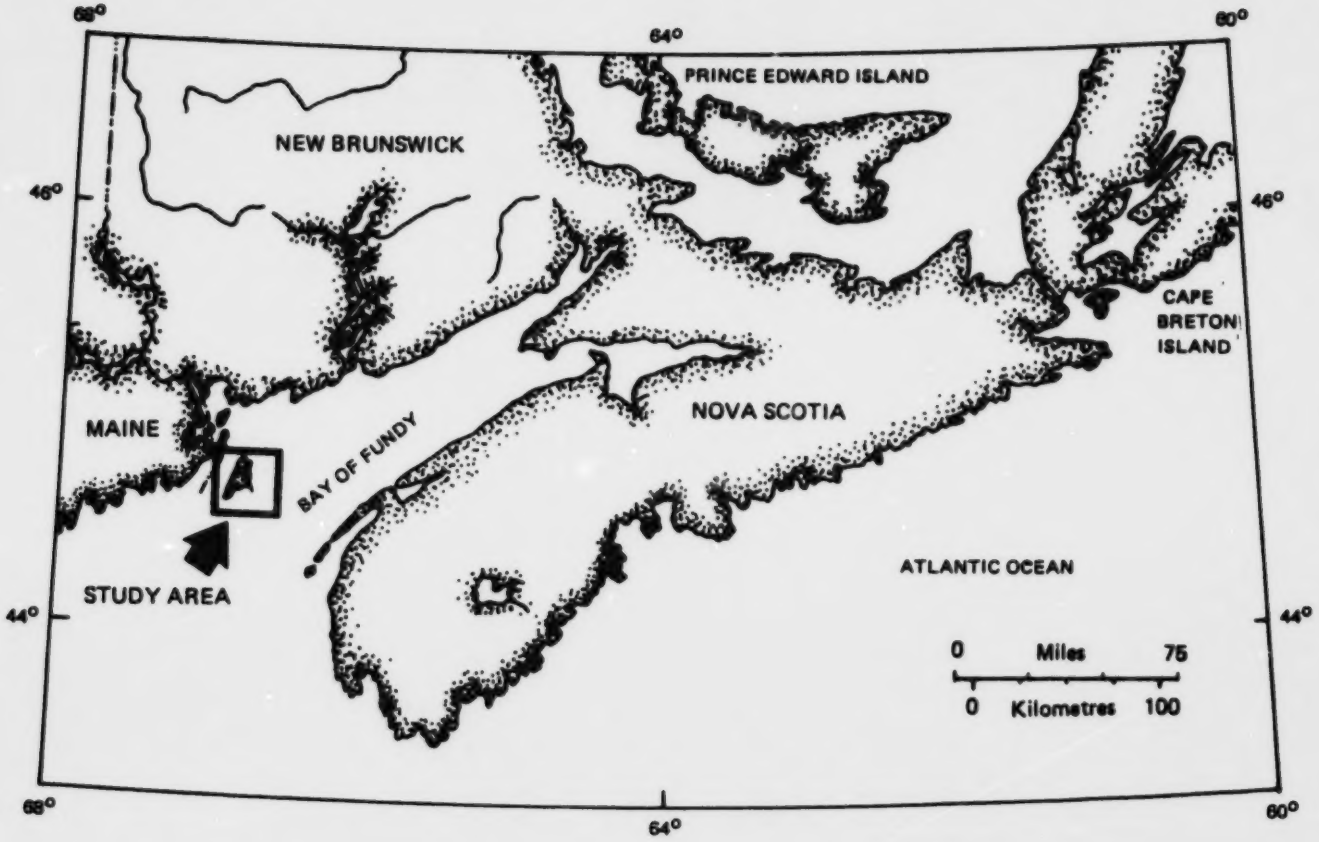
Spot dives were conducted by moving into shallow water at a predetermined site. Divers entered the water and roamed widely over the bottom at various depths recording the substrate, abundance of resident organisms, water temperature, and depth relationships encountered. Where quantitative data were required, a meter square was placed at random on the bottom and the numbers of animals within this square were counted. Upon completion of the dive, the diver was debriefed using a special Site Data Form.

"Sweep" dives were used where it was necessary to cover wide areas in shallow water. In such cases, a diver was towed on a line about 30 feet behind an outboard-powered dinghy. When areas of interest were encountered the diver released the line and examined the bottom. Data were recorded as outlined above.

Transects were run where detailed information on a site was required as shown in Figure 2.1.2. The dive team consisted of two divers, a dive-tender, and boat operator-debriefer. The divers were responsible for examination of the transect area, recording of data, and the collection of specimens. The dive-tender was responsible for deploying and picking up the diving team and insuring their safety on the surface. The boat operator-debriefer was responsible for maintaining the support vessel, recording the dive site data, and debriefing the divers at the conclusion of each dive to insure that the maximum amount of information was obtained. On steep cliffs running into deep water, one end of the transect line was anchored at the base of the cliff or, if possible, at the low water mark and laid across the bottom at right angles to the shore and anchored to the outer end. When currents permitted, the survey vessel was anchored to the other end of the transect line. When this was not possible, both ends of the transect line were marked with a buoy. In swift current, a safety line with life jackets attached was allowed to trail several hundred feet downstream from the outer buoy.

Two divers entered the water at the anchor line or outer marker buoy and proceeded to dive to the other end of the transect line. Until 1976, numbered markers at 10 foot intervals on the transect line indicated each of thirty stations on the line. From 1977 onwards a 100 meter transect line was used with stations at 3 meter intervals. At each station, the diver-recorder recorded the depth, substrate, and organisms. Where quantitative data were required a meter square was placed at the stations and counts were made within the square. Any distinct change in substrate or faunal composition which occurred between stations was also recorded. This activity was carried out along the length of the transect line to the high water mark where possible. Where this was not possible due to the steepness of a cliff, observations were made from low water. When data were required beyond the outer limit of the transect line, spot dives were made at various depths to a maximum of 100 feet. In these cases a "Shot" line was used with a stand-by diver acting as safety man.

Where visibility was at or near zero, all observations and records were made using underwater lights.



3.1.1. THE STUDY AREA

3. THE STUDY AREA

3.1 THE STUDY AREA - THE GRAND MANAN ARCHIPELAGO

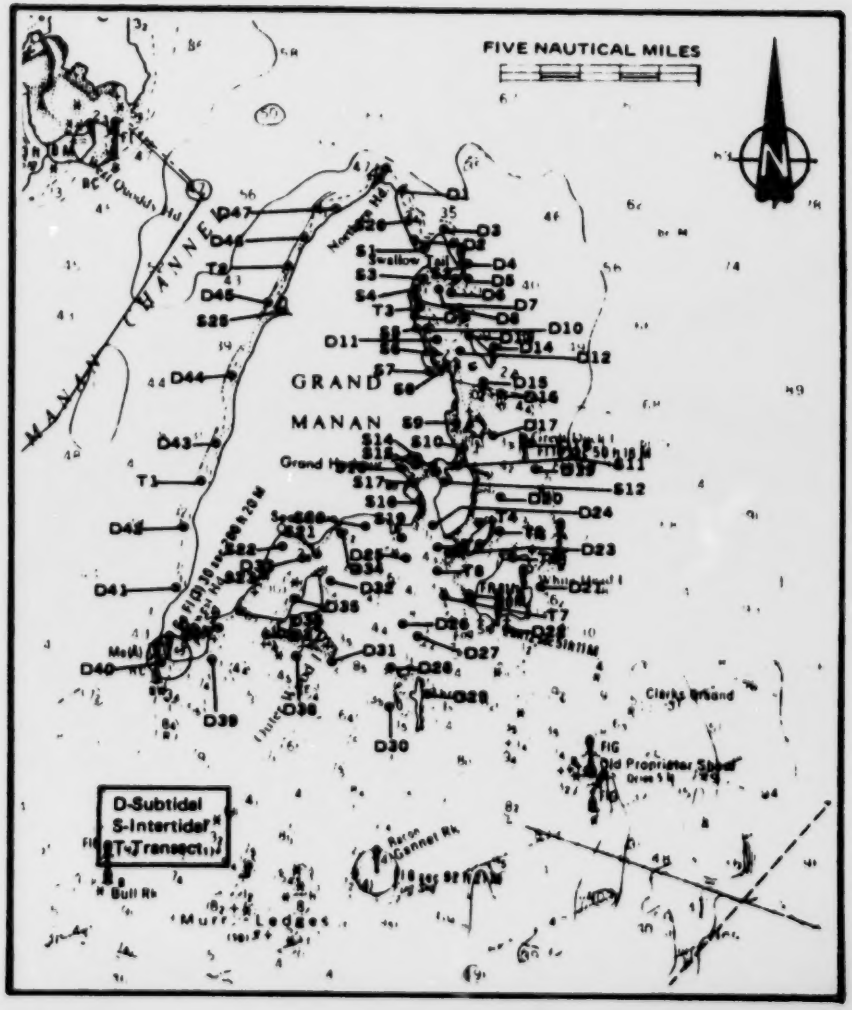
The study area for Zone 4, the Grand Manan Archipelago, was considered to include all tidal waters within the confines of the 100 foot contour.

3.2 STUDY SITES

In all, 47 subtidal and 26 intertidal spot examinations, 9 transects and 8 water quality sites were visited as shown in Figures 3.2.1 and 3.2.2. Where available, additional data were incorporated with new field data during the preparation of the manuscript. Original site data are on file at Marine Research Associates Ltd. offices at Deer Island, N.B.

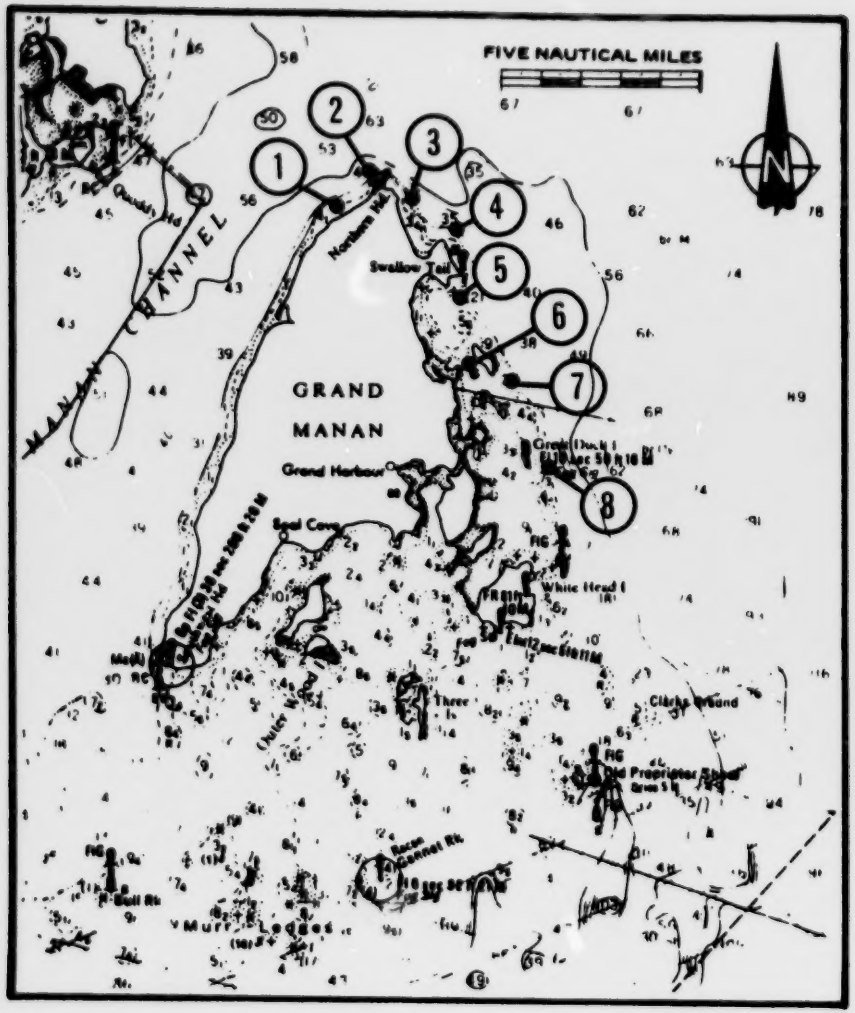
3.2.1 STUDY SITES

THE GRAND MANAN ARCHIPELAGO



3.2.2
WATER QUALITY SITES

THE GRAND MANAN ARCHIPELAGO



4. PHYSICAL DESCRIPTION

4.1 INTRODUCTION . This section is devoted to a general description of the physical aspects of the study area since, to a large degree, they directly relate to the marine resources of the region

Politically, the Grand Manan Archipelago is part of Charlotte County, New Brunswick, Canada, but it lies at the mouth of the Bay of Fundy just 5.79 miles in shortest distance from West Quoddy Head in Maine and approximately 25 miles from the New Brunswick mainland.

4.2 TOPOGRAPHY. The Grand Manan Archipelago is composed of nineteen islands of varying size and numerous small ledges.

Of the islands in the Archipelago, Grand Manan Island is the most varied topographically. Its west coast, from Northern Head to Southern Head, is characterized by an abrupt cliff, ranging from 53 feet to 400 feet in height, only broken by embayments at Little Dark Harbour, Dark Harbour, and Money Cove, Eastward, heights of 250 to 400 feet are maintained to about the middle of the island where the elevation gradually lessens until the characteristically low and relatively level east coast is reached. Here the coastline is very irregular and characterized by a number of coves and harbours of which Deep Cove, Seal Cove, Grand Harbour, Flagg Cove, and Whale Cove are the most conspicuous. Small rocky bluffs are not uncommon here, but tidal flats and sand and gravel beaches predominate.

The small islands lying to the east of Grand Manan Island are all, in contrast, relatively low lying. In fact the highest elevation reached on these islands is 74 feet above sea level at White Head Island. Like the east coast of Grand Manan the shorelines of these islands exhibit tidal flats, and sand and shingle beaches, as well as rugged bluffs; the most impressive of which are found on the seaward side of Outer Wood Island and Kent Island.

The principal islands of the Grand Manan Archipelago and their estimated greatest lengths and widths are given in Table 4.2.1.

There are numerous topographic features in the study area which are considered to be unique or unusual. These are listed and described in Table 4.2.2. The Topography of Grand Manan is illustrated in Figure 4.2.1.

4.2.1
TOPOGRAPHY

THE GRAND MANAN ARCHIPELAGO

TABLE 4.2.1 PRINCIPAL ISLANDS OF THE GRAND MANAN ARCHIPELAGO showing estimated greatest lengths and widths.

ISLANDS	EST. GREATEST LENGTH (miles)	EST. GREATEST WIDTH (miles)
1. Grand Manan	15.31	6.70
2. Ross	2.40	1.30
3. Cheney	1.40	0.50
4. White Head	2.10	1.80
5. Long	1.20	0.35
6. High Duck	0.20	0.10
7. Low Duck	0.25	0.15
8. Nantucket	0.70	0.50
9. Great Duck	0.60	0.25
10. Inner Wood	2.00	0.80
11. Outer Wood	0.85	0.45
12. West Green	0.15	0.05
13. White Horse	0.10	0.05
14. North Green	0.15	0.10
15. South Green	0.35	0.05
16. Hay	0.50	0.30
17. Sheep	0.55	0.15
18. Kent	1.85	0.50

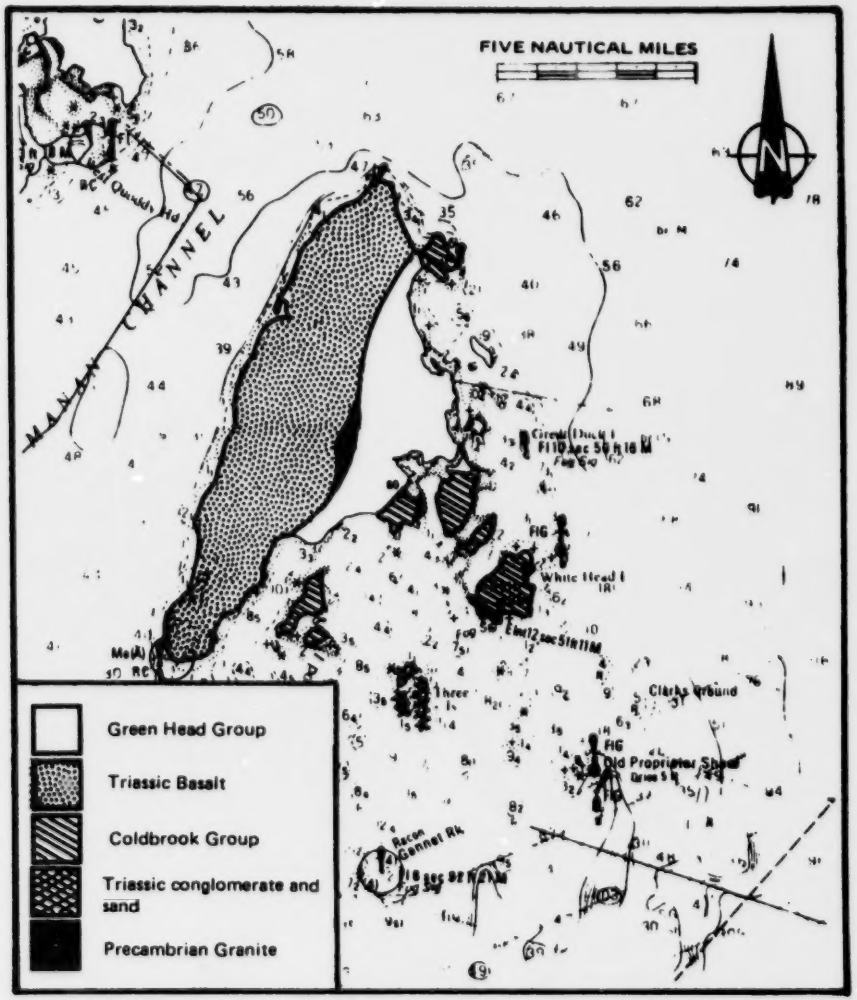
TABLE 4.2.2 Outstanding coastal topographic features of the Grand Manan Archipelago.

1. North Head	Abrupt high cliff
2. Seven-days-works	Cliff showing stratification
3. Hole-in-the-wall	Rock formation with arch
4. Dark Harbour	Natural salt pond
5. Red Point	Contact point of two formations of widely different age
6. Jack Tar Cove	Cave
7. The Sheep	Large white glacial boulders in gravel bank
8. Southern Head	Abrupt high cliff

4.3 GEOLOGY. Geologically, Grand Manan is an uplifted fault block which arose during late or post Triassic time (Hale, per. comm), a period of considerable faultblocking in the Bay of Fundy area. Grand Manan has been of interest to geologists because of a major fault which divides the Island into two areas of distinctly different age and origin

4.3.1
GEOLOGY

THE GRAND MANAN ARCHIPELAGO



As shown in Figure 4.3.1 this fault runs approximately in a straight line from Whale Cove at the north end of the Island to Red Head on the southeast coast.

West of the fault, the Island is underlain by volcanic basalt " with which are associated minor amounts of reddish and brownish sandstone and conglomerate. The rocks are very fresh, and are similar to others of known Triassic Age in the Bay of Fundy region", (Alcock, 1946). At the fault, this rock meets directly with formations of Archaean Age, which underlies most of the eastern portion of Grand Manan Island. It consists of "massive white quartzites, reddish, grey, and greenish quartzites, argillites, argillaceous sand, and locally conglomeratic beds, mica schists, and limestone". (Alcock, 1946). Also composed of this type of rock are Long, High Duck, Low Duck, Nantucket, and Great Duck Islands, as well as the northern portion of Ross Island. The remaining portion of Ross Island and Cheney, White Head, Northern Green, Southern Green, Inner Wood, Outer Wood, and Western Green Islands are underlain by rock of Proterozoic (?) Age. This assemblage is composed largely of volcanic rocks, but also contains some sedimentary strata. "The volcanic members, including both massive flows and fragmental types, consist largely of greenish andesites, locally amygdaloidal, but light colored rhyolites are abundant in places". On Kent Island Precambrian granite cuts through limestone and quartzite, (Alcock, 1946).

On Grand Manan Island, the soils are apparently derived from the underlying formations. Weatherby and Adams (1945) found these soils to be weakly alkaline. Some fifteen tests made by them gave "uniformly neutral or circumneutral pH values (6 plus to 7 plus)". As they pointed out, this alkalinity is not sufficient to prevent the local formation of bogs having very high acidity.

Grand Manan Island was glaciated as indicated by smooth and striated surfaces found on the coast and the highest areas as well. In addition, Alcock (1946) reported that numerous erratics were observed at the higher elevations. The information is confusing, however, since there appear to be three sets of striae, an apparently old group which tends from north 70 degrees east to east, another group which tends south 50 degrees east, and the youngest group which tends from south to south 15 degrees east. This variation in strike suggests at least three periods of glacial advance. The intensity of glaciation is difficult to assess, but it is possible that it was less severe on the Island than on the mainland as suggested by the rugged character of the west coast of Grand Manan.

The spectacular cliffs of Grand Manan have, apparently, attracted numerous geologists and reference to the Island can be found in numerous scientific and popular articles. The first major work was carried out by Gesner (See Charles, 1936). Sabina (1964) visited the Island and listed the following as being of interest to the mineral collector: Scolecite, Heulandite, Laumonite, Analcite, Natrolite, Epistilbite, Thomsonite, Stilbite, Quartz Crystals, Copper (native), Hematite, Chlorite, and Magnetite.

The geology of the study area is illustrated in Figure 4.3.1.

4.4 CLIMATE AND METEOROLOGY. The study area is influenced by a north-temperate marine climate which is characterized by warmer winter temperatures and cooler summer temperatures than inland, extensive periods of summer fog, and strong fall and winter winds.

a) Temperature. Temperatures in the study area, averaged from 30 years data, are shown in Table 4.4.1 and Figure 4.4.1. Comparative data for two mainland stations are also illustrated.

b) Precipitation. Average monthly values for rainfall and snowfall are given in Table 4.4.1 and Figure 4.4.2 for rainfall and 4.4.3 for snowfall for the study area and two comparative mainland locations.

c) Fog. Available fog data for Eastport, Maine, Campobello, N.B. and Grand Manan, N.B. are summarized in Figure 4.4.4. Being more oceanic in its location, the study area is influenced by more fog than either Eastport or Campobello.

d) Wind. The Archipelago is openly exposed to the sea and, as a result, the seaward portions of the islands are subjected to almost daily winds from any direction Although no data for Grand Manan Island were available, Gannet Rock lighthouse recorded an average wind speed of 20.71 m.p.h. for 1961 (Ingersoll, Jan. 11, 1962). Grand Manan Island would, undoubtedly, have an average somewhat lower than this. The Archipelago frequently receives the full force of severe storms. Long-term summaries for wind speed are presented in Table 4.4.2 for Eastport, Maine.

e) Sunshine. Because of the direction of the prevailing winds, the northern portion of Grand Manan Island generally enjoys more favorable climatic conditions, since wind speed is reduced after passing over the southern portion of the Island and fog often dissipates before reaching this area. As a result, longer periods of sunshine and warmer temperatures are experienced in the North Head region. Available clear-cloudiness data for Eastport, Maine are shown in Table 4.4.3.

4.5 FRESHWATER RESOURCES. Several sphagnum bogs are present in the low lying, poorly drained, areas of the eastern coast of Grand Manan Island. An extensive salt marsh is to be found at Castalia and a brackish pond at Whale Cove. Some sixteen or more freshwater ponds are scattered in depressions over the Island. Most of these are surrounded by bog vegetation and have the characteristic warm coffee-colored water of such lakes. However, several, such as Miller's Pond, have sand and gravel bottoms and cool clear water. Approximately seventeen brooks of various sizes drain the Island. Only two of these, Seal Cove Brook and Grand Brook, are of any size and extent. Both have cut valleys in the uplands of mid-island. Several extensive meadows are found along these brooks. Poor drainage on such islands as White Head Island and Cheney Island, has resulted in the formation of sphagnum bogs. Brackish or freshwater ponds are found on Ross Island, Cheney Island, White Head Island, Inner Wood Island, Hay Island, and Sheep Island.

TABLE 4.4.1 . COMPARATIVE CLIMATOLOGICAL DATA FROM GRAND MANAN (GM; averaged from 30 years data) AND TWO MAINLAND STATIONS, FREDERICTON (F; averaged from 67 years data) AND ST. ANDREWS (SA; averaged from 19 years data). Temperatures are in degrees fahrenheit. Precipitation and snowfall are in inches, T equals Trace amounts. (Data from Climatic Summaries for selected meteorological stations in the Dominion of Canada. Vol. 1.)

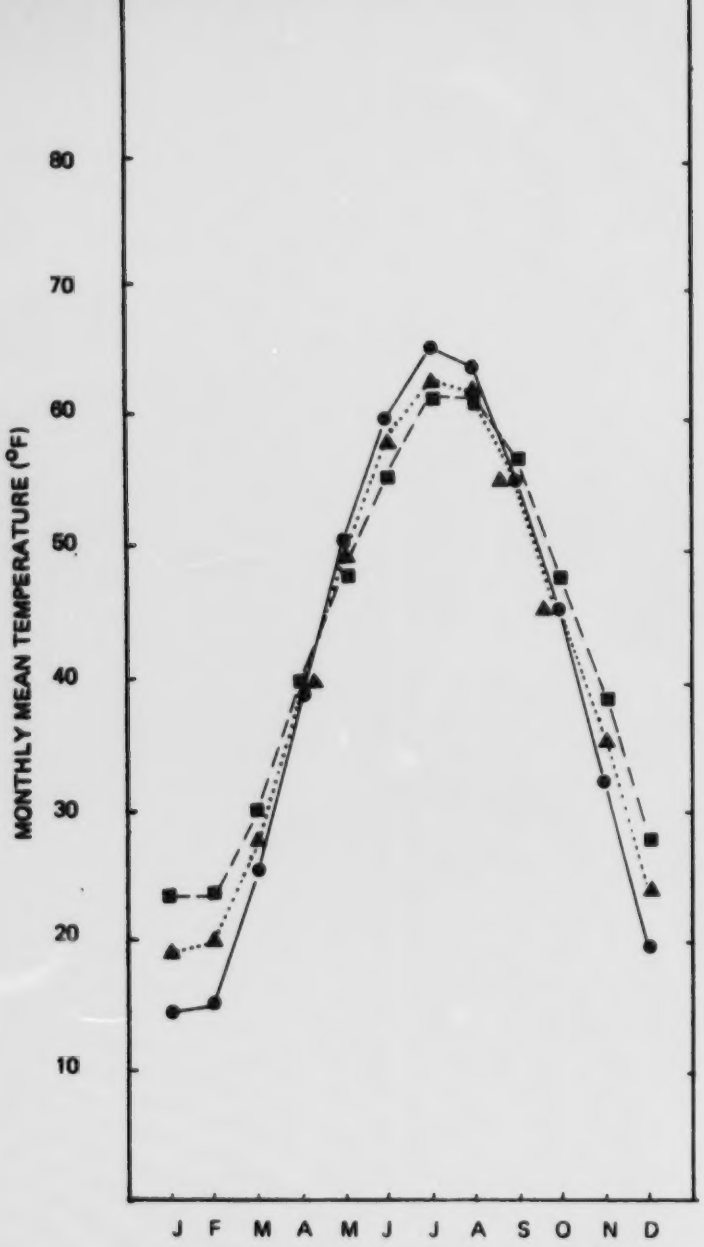
MONTH	AV . DAILY MAX. TEMP.			AV. DAILY MIN. TEMP.			AV. DAILY MEAN TEMP.			AV. RAINFALL			AV. SNOWFALL		
	F	GM	SA	F	GM	SA	F	GM	SA	F	GM	SA	F	GM	SA
Jan.	24	32	29	3	15	9	14	24	19	3.87	4.86	4.92	23.5	17.2	23.8
Feb.	26	21	29	3	16	11	15	23	20	3.11	3.83	3.49	22.1	18.9	22.9
Mar.	37	37	35	16	24	20	26	30	27	3.58	4.76	3.58	15.9	12.7	16.6
Apr.	49	46	47	29	33	30	39	40	39	2.94	3.37	2.75	6.5	5.5	6.6
May	63	56	58	39	41	39	51	48	49	3.11	3.61	2.73	0.2	T	-
Jun.	72	64	68	48	48	48	60	56	58	3.75	3.13	3.18	-	-	-
July	77	70	72	55	54	53	66	62	63	3.53	2.80	2.78	-	-	-
Aug.	75	69	71	53	54	53	64	62	62	3.99	3.29	3.01	-	-	-
Sept.	67	64	64	45	50	48	56	57	56	3.56	3.45	3.06	-	-	-
Oct.	55	54	54	36	42	38	46	48	46	4.11	4.21	3.70	0.4	0.3	-
Nov.	41	45	44	25	33	28	33	39	36	3.82	5.01	4.00	7.7	2.8	4.8
Dec.	28	36	33	10	20	15	19	28	24	3.43	4.43	3.89	19.2	12.1	10.4
Year	51	50	50	30	36	32	41	43	41	42.80	46.75	41.09	95.5	69.5	85.1

TABLE 4.4.2 RECORDS OF WIND AT EASTPORT, MAINE. Mean hourly speed (MPH) from 66 years data, Fastest speed (MPH) from 79 years data, Direction of fastest speed, and year of fastest speed.

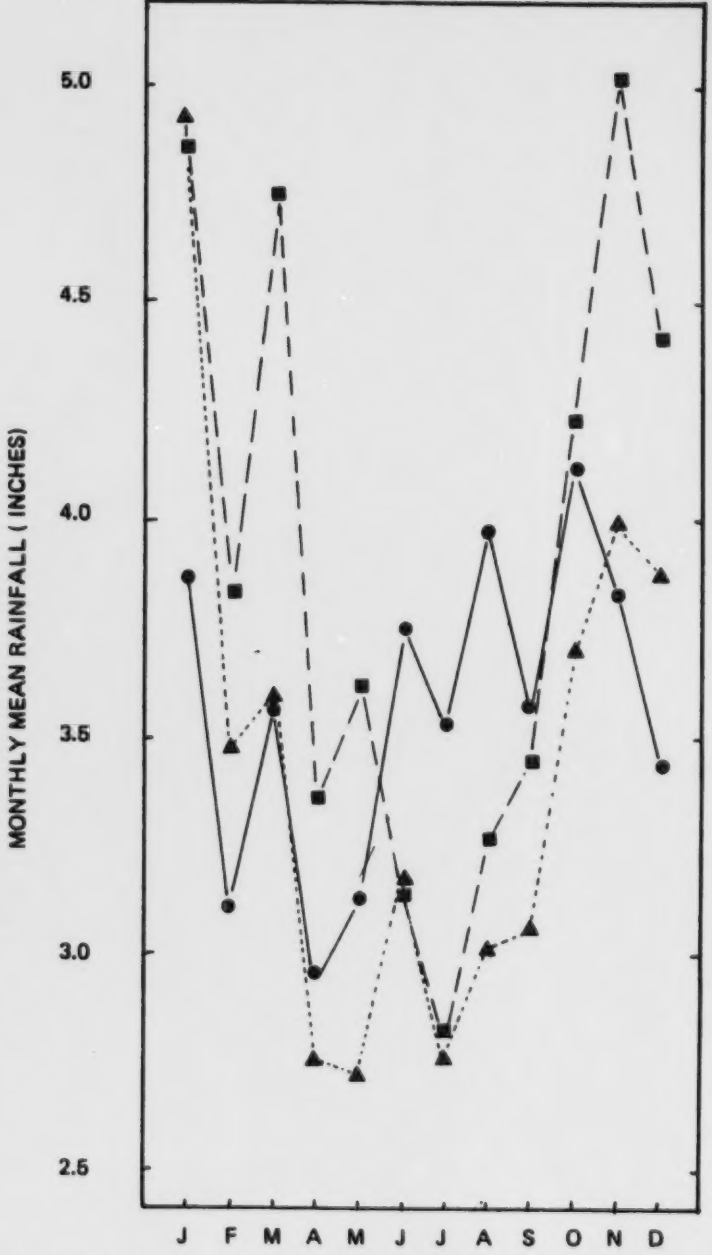
MONTH	MEAN HOURLY SPEED	FASTEST	DIRECTION	YEAR
Jan	13.5	70	SE	1928
Feb	13.3	62	NE	1914
Mar	12.6	61	E	1931
Apr	11.4	60	E	1934
May	9.7	57	SE	1924
June	8.4	49	E	1918
July	7.5	47	NE	1912
Aug	7.4	51	NE	1917
Sept	8.7	47	NE	1940
Oct	10.7	76	E	1917
Nov	12.3	76	NE	1919
Dec	12.9	83	E	1917

TABLE 4.4.3 RECORDS OF SUNSHINE AT EASTPORT, MAINE. Based on 70 years data. Expressed as mean number of days per month for clear, partly cloudy and cloudy.

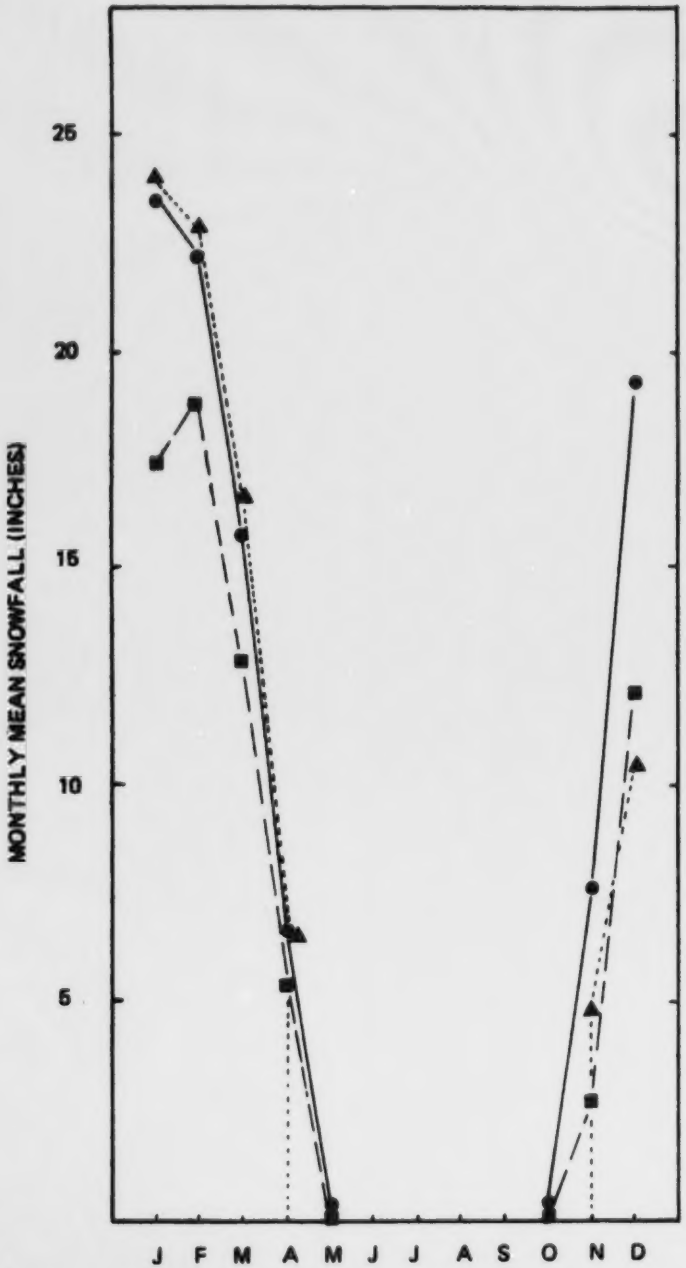
MONTH	CLEAR	PARTLY CLOUDY	CLOUDY
Jan	8	8	15
Feb	8	7	13
Mar	8	9	14
Apr	7	9	14
May	7	11	13
June	6	12	12
July	7	13	11
Aug	8	12	11
Sept	9	9	12
Oct	8	9	14
Nov	5	8	17
Dec	7	8	16
TOTALS	88	115	162



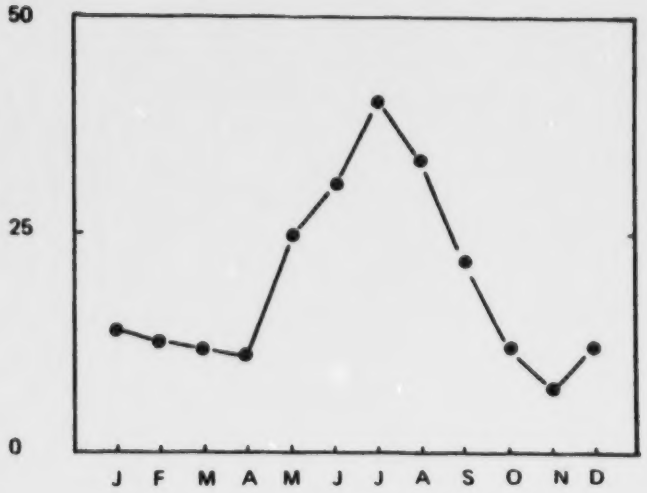
4.4.1 LONG-TERM MONTHLY MEAN TEMPERATURES FOR FREDERICTON (●), ST. ANDREWS (▲) AND GRAND MANAN (■).



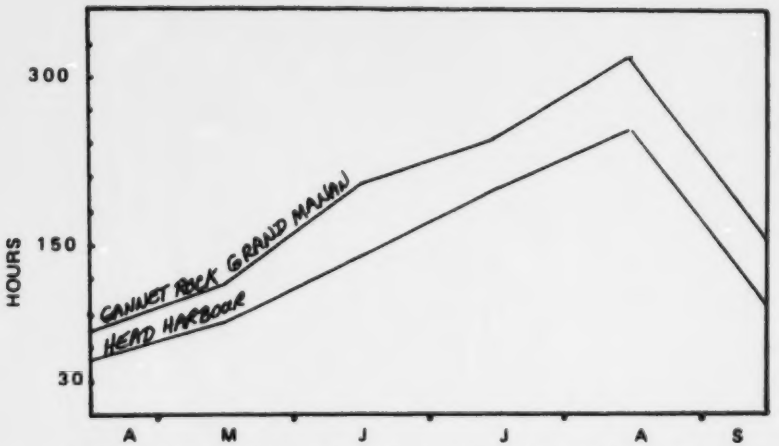
4.4.2 LONG TERM MONTHLY RAINFALL FOR FREDERICTON (●), ST. ANDREWS (▲) AND GRAND MANAN (■).



4.4.3 LONG-TERM MONTHLY MEAN SNOWFALL FOR FREDERICTON (●), ST. ANDREWS (▲) AND GRAND MANAN (■).



LONG-TERM RECORD OF MONTHLY FOG FOR EASTPORT, MAINE



Hours of fog alarm at two lighthouses in the Bay of Fundy, 1932.

4.4.4 FOG DATA FOR GRAND MANAN, CAMPOBELLO AND EASTPORT

5. OCEANOGRAPHY

5.1 INTRODUCTION. While Grand Manan's topography and oceanographic parameters do not appear to favor great diversity of benthic invertebrates they do, however, produce unusual growth of certain species and the area is, in this respect, also unique. In this section we therefore document available oceanographic data for the area under study.

5.2 BATHYMETRY. Figure 5.2.2 illustrates a sketch of the Grand Manan Archipelago showing the 6 fathom contour. The maximum depth among the islands reaches only about 60 feet while offshore from the islands the bottom drops to over 400 feet.

5.3 SUBSTRATES. Figures 5.3.1 to 5.3.3 illustrate the locations of various substrates recorded in the study area. The area is dominated by rocky shores usually dropping subtidally to cobble, boulders and ledge. Sandy and muddy bottoms are common. Shore types of the area are illustrated in Figure 5.3.4.

5.4 TIDES. The study area is influenced by the large Bay of Fundy tidal fluctuations. The tidal rise and fall is in excess of 20 feet in the vicinity of the study area.

5.5 CURRENTS. Table 5.5.1 shows the recorded speed of currents at various localities in the study area.

Areas with dangerous water occupy much of the water to the southeast of the islands and operations require expert local knowledge of current patterns as well as the effect of wind.

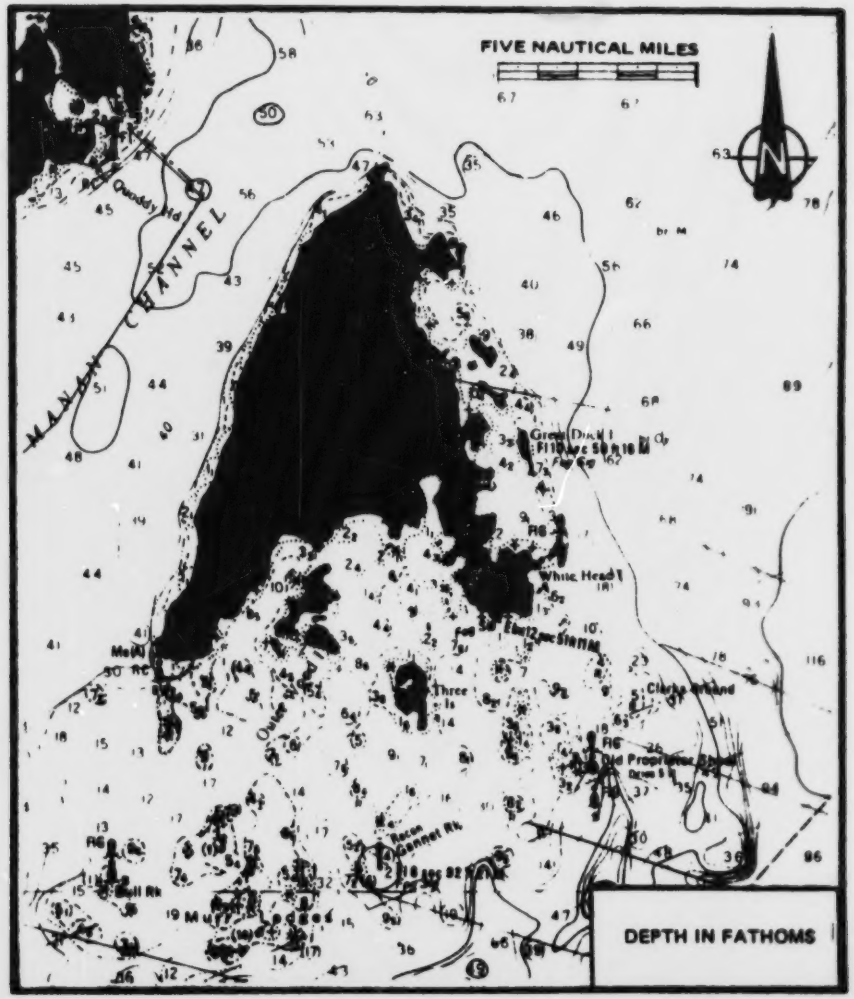
Figure 5.5.2 and 5.5.3 illustrate surface circulation patterns in the vicinity of the study area for winter, spring, summer and fall respectively.

5.6 LIGHT AND WATER CLARITY. Water clarity and the consequent penetration of light are important factors in terms of biological productivity. Water clarity tends to be relatively poor in the study area as a whole. However, there are wide variations from locality to locality, as well as from season to season. Generally, water clarity is the poorest in muddy embayments and among islands where currents favor sedimentation. Clarity is usually low during the summer and high during the winter. Also, inshore waters tend to have low visibility and offshore waters tend to have high visibility at any given time. For example, among the islands at Grand Manan effective visibility is usually 10 to 15 feet while offshore visibility averages 15 to 20 feet and may reach 30 feet or more at certain times of the year.

5.7 TEMPERATURE. Bay of Fundy waters are typically cold with temperatures ranging from as low as Minus 1.7 degrees C. in mid-winter, to summer highs of approximately 15 degrees C. Table 5.7.1 shows the average seasonal and annual temperatures in the Quoddy Region. There

5.2.2
BATHYMETRY

THE GRAND MANAN ARCHIPELAGO



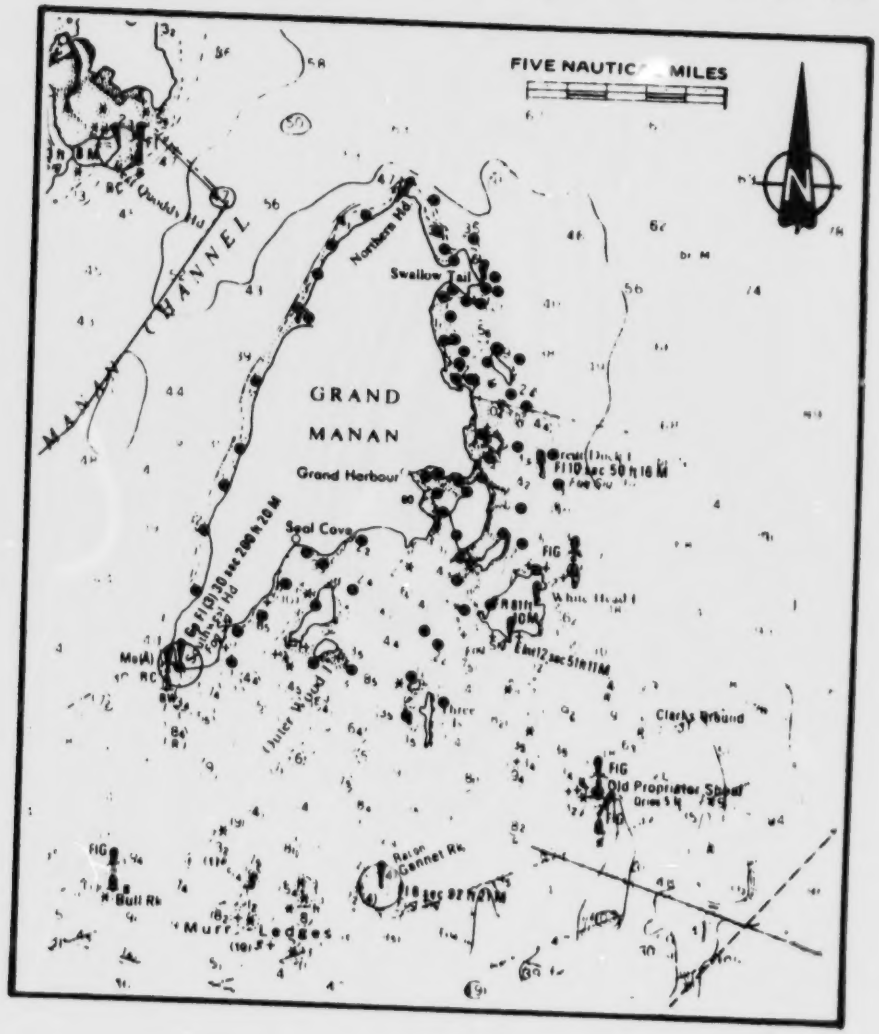
is usually little variation in temperature between the Deer Island area and the Grand Manan region while in Passamaquoddy Bay temperatures very appreciably. In general, temperatures there tend to be higher in the summer and lower in the winter than "outside". Temperatures recorded during this survey are given in Table 5.7.2.

5.8 SALINITY. The Grand Manan region is surrounded by open water and high salinities. As can be seen from Table 5.7.1 and Figure 5.8.1; salinities here tend to be higher than in Passamaquoddy Bay, for example, where large volumes of freshwater are entering the Bay. In the study area, on the other hand, freshwater influence is minimal. Salinities recorded during this survey are given in Table 5.7.2.

5.9 WAVES AND EROSION. The Grand Manan Archipelago is openly exposed to winds from all directions and, consequently, the effect of wave action is considerable and erosion is relatively constant. Generally the pattern of erosion for the area is typical with large rock rubble at the base of the cliff, grading slowly to fine mud in deeper water at some distance from the cliff.

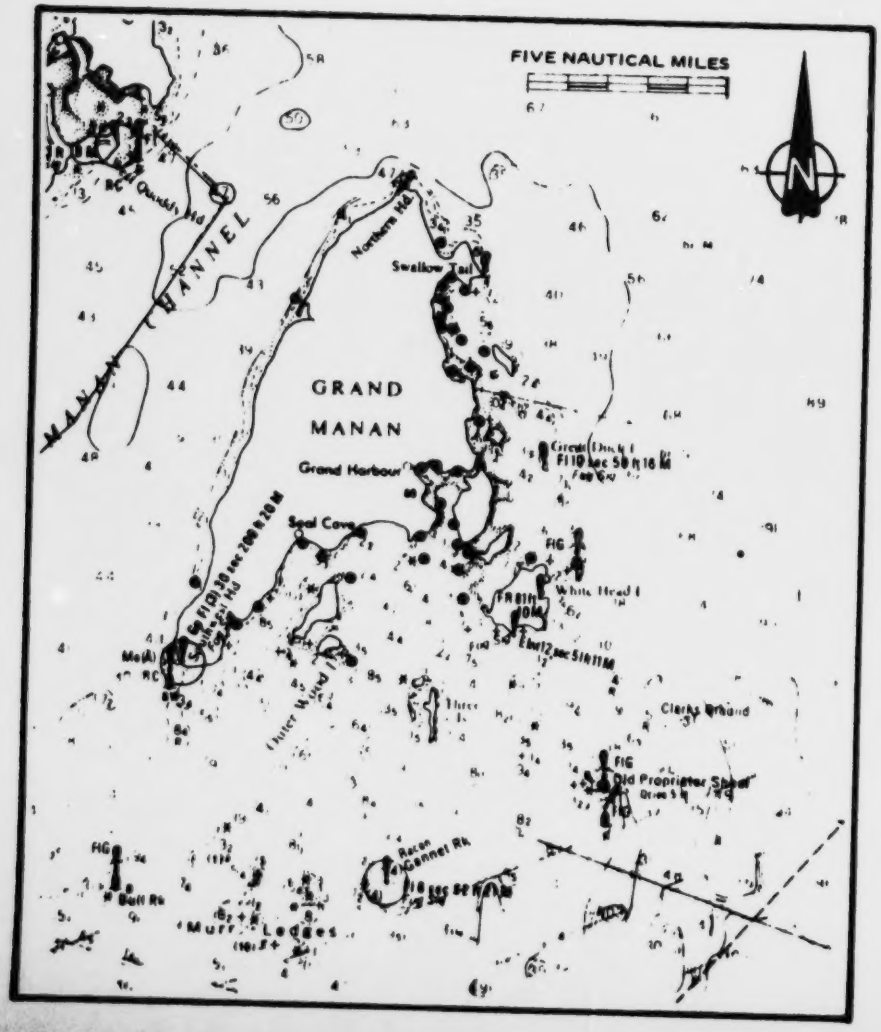
5.3.1 OCCURRENCE OF COBBLE, BOULDER AND LEDGE

THE GRAND MANAN ARCHIPELAGO



5.3.2
OCCURRENCE OF SAND

THE GRAND MANAN ARCHIPELAGO



5.3.3
OCCURRENCE OF MUD

THE GRAND MANAN ARCHIPELAGO

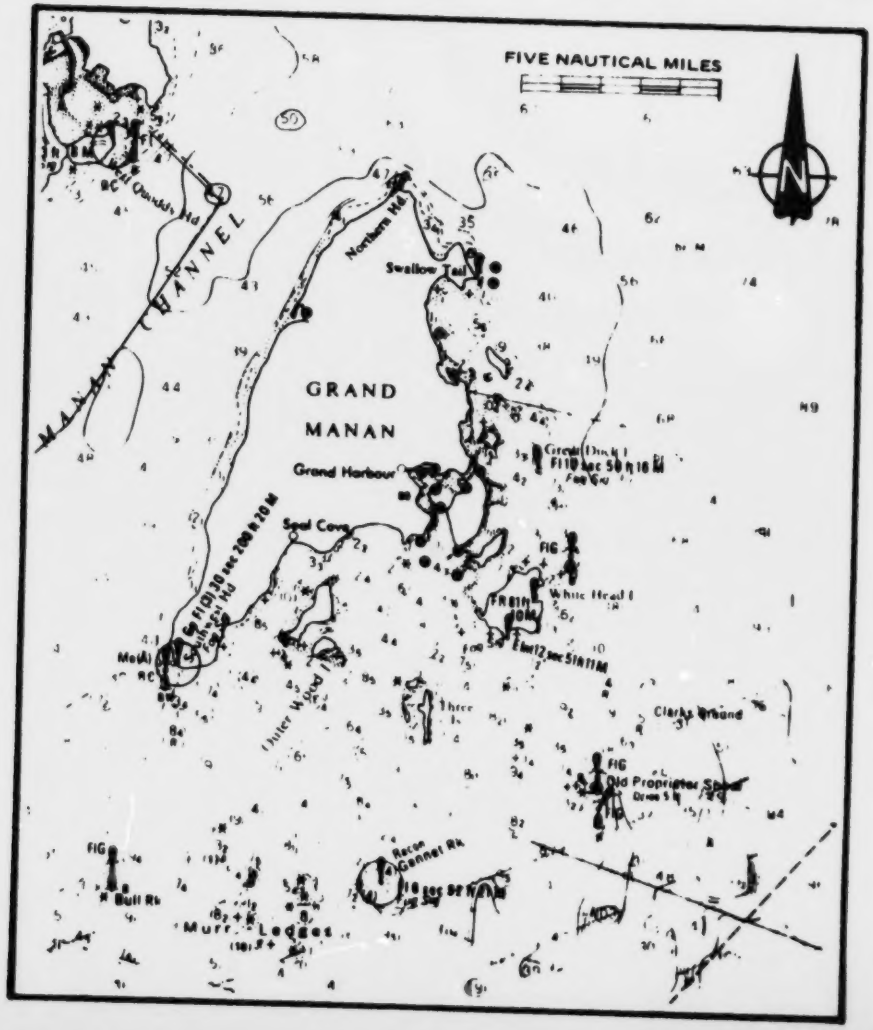


TABLE 5.7.1. AVERAGE SEASONAL AND ANNUAL TEMPERATURES (DEGREES C) AND SALINITIES (0/00) IN THE QUODDY REGION. (Shenton and Horton, 1973)

	1957		1958	
	TEMPERATURE	SALINITY	TEMPERATURE	SALINITY
COBSCOOK BAY				
Winter	1.57	31.51	3.14	31.56
Spring	6.08	31.70	6.74	30.85
Summer	11.23	31.88	11.12	32.30
Autumn	8.99	32.37	8.98	32.20
Mean	6.67	31.87	7.50	31.73
PASSAMAQUODDY BAY				
Winter	1.02	31.35	2.89	31.06
Spring	6.39	31.24	6.07	29.40
Summer	11.79	31.85	11.70	31.44
Autumn	9.50	32.35	8.67	31.85
Mean	7.18	31.92	7.33	30.94
LETITE PASSAGE				
Winter	1.50	31.80	3.51	31.91
Spring	5.95	31.72	5.59	30.91
Summer	11.10	32.21	10.62	31.85
Autumn	9.43	32.61	8.79	32.14
Mean	6.99	32.09	7.13	31.70
WESTERN PASSAGE				
Winter	1.72	31.75	3.19	31.64
Spring	5.71	31.83	5.50	31.00
Summer	10.86	32.29	10.47	31.85
Autumn	9.46	31.73	9.11	32.18
Mean	6.94	32.15	7.07	31.67
OUTSIDE				
Winter	2.60	32.35	3.79	32.20
Spring	4.99	32.05	4.92	31.39
Summer	10.21	32.35	9.68	32.12
Autumn	9.62	32.70	9.21	32.47
Mean	6.86	32.36	6.90	32.06

TABLE 5.7.2 TEMPERATURE (°C) SALINITY (°/oo) AND pH (at 10°C)
RECORDS FROM GRAND MANAN, JULY, 1978

STATION		6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8
DATE		July 27	July 27	July 27	July 27	July 27	July 27	July 27	July 27
DEPTH									
0	°C	8.7	8.9	9.2	9.7	10.3	9.9	9.9	9.1
	°/oo	30.1	30.0	29.9	29.9	29.9	29.9	30.1	30.3
	pH	-	7.52	-	7.43	7.69	-	-	7.68
1.5 M	°C	8.7	8.7	8.9	9.4	10.3	9.8	9.5	8.9
	°/oo	30.1	30.0	30.1	30.1	29.8	29.9	30.1	30.1
3.0	°C	8.5	9.6	9.7	8.8	10.1	9.9	9.2	8.8
	°/oo	30.2	30.1	30.1	30.2	29.9	30.0	30.2	30.0
6.0M	°C	8.4	8.5	8.6	8.7	8.9	9.8	8.6	8.5
	°/oo	30.2	30.1	30.1	30.2	30.1	29.9	30.4	30.0
9.0M	°C	8.3	8.5	8.5	8.6	8.6	-	8.5	8.4
	°/oo	30.1	30.2	30.2	30.2	30.1	-	30.2	30.2
12.0M	°C	8.2	8.5	8.5	8.6	8.5	-	8.5	8.4
	°/oo	30.2	30.1	30.2	30.2	30.2	-	30.4	30.2

*Dr. D. Gaskin's field crew, University of Guelph, Co-operated in the collection of these data.

5.3.4
SHORE TYPES

THE GRAND MANAN ARCHIPELAGO

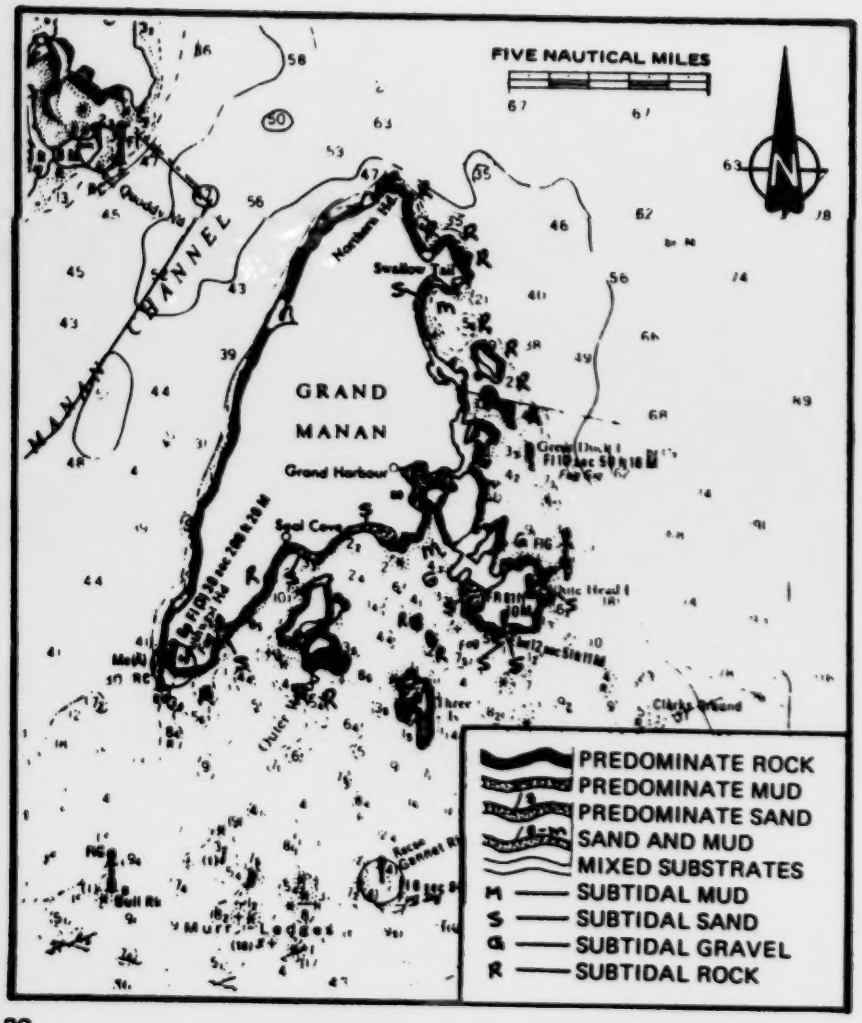
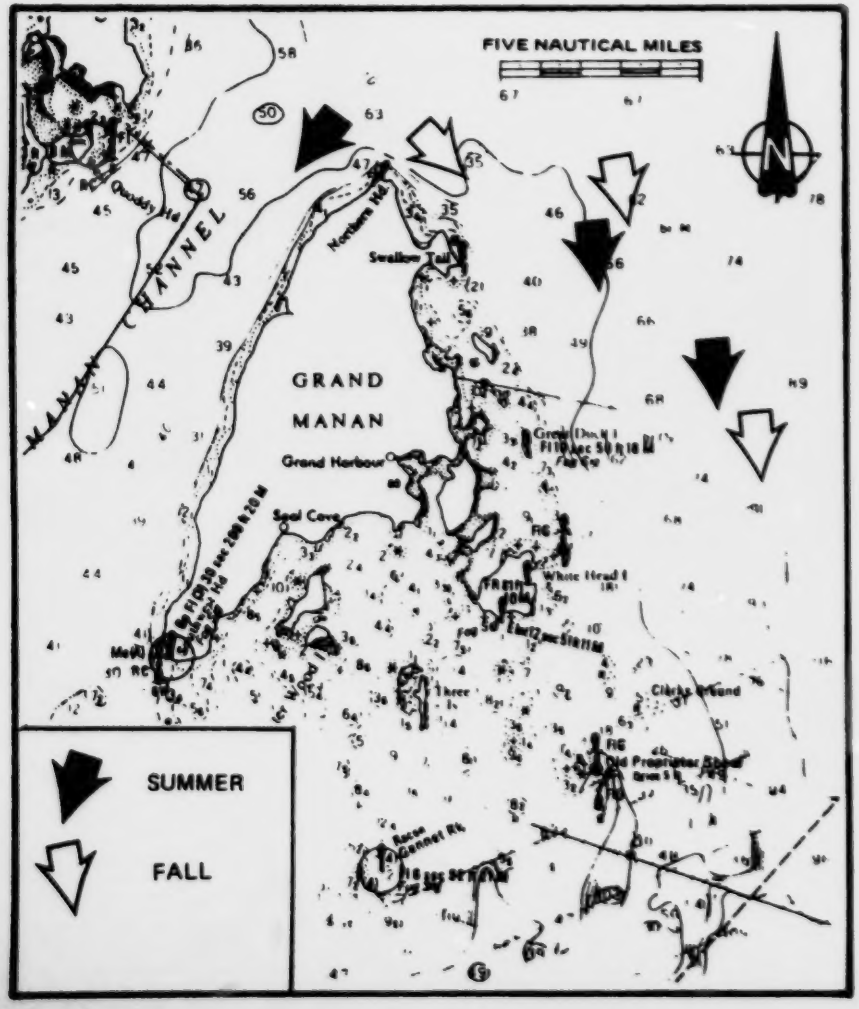


TABLE 5.5.1 CURRENT MEASUREMENTS RECORDED FOR THE GRAND MANAN SUBREGION.

LOCALITY	RECORDED SPEED	SOURCE
East Great Duck Is.	3-4 knots	Can. Hyd. Ser. Chart D7-4340
Crawley Shoal	4-6 knots	Can. Hyd. Ser. Chart D7-4340
Murr Ledges	3 knots, 3-3/4 kts.	Can. Hyd. Ser. Chart D7-4340
Machias Seal Is.	about 3 knots	Can. Hyd. Ser. Chart D7-4340
Grand Manan Channel	about 3-1/2 kts.	Can. Hyd. Ser. Chart D7-4340
Red Head	about 2 kts.	Can. Hyd. Ser. Chart D7-4340
Grand Manan Channel	up to 3 kts.	McLellan, 1951

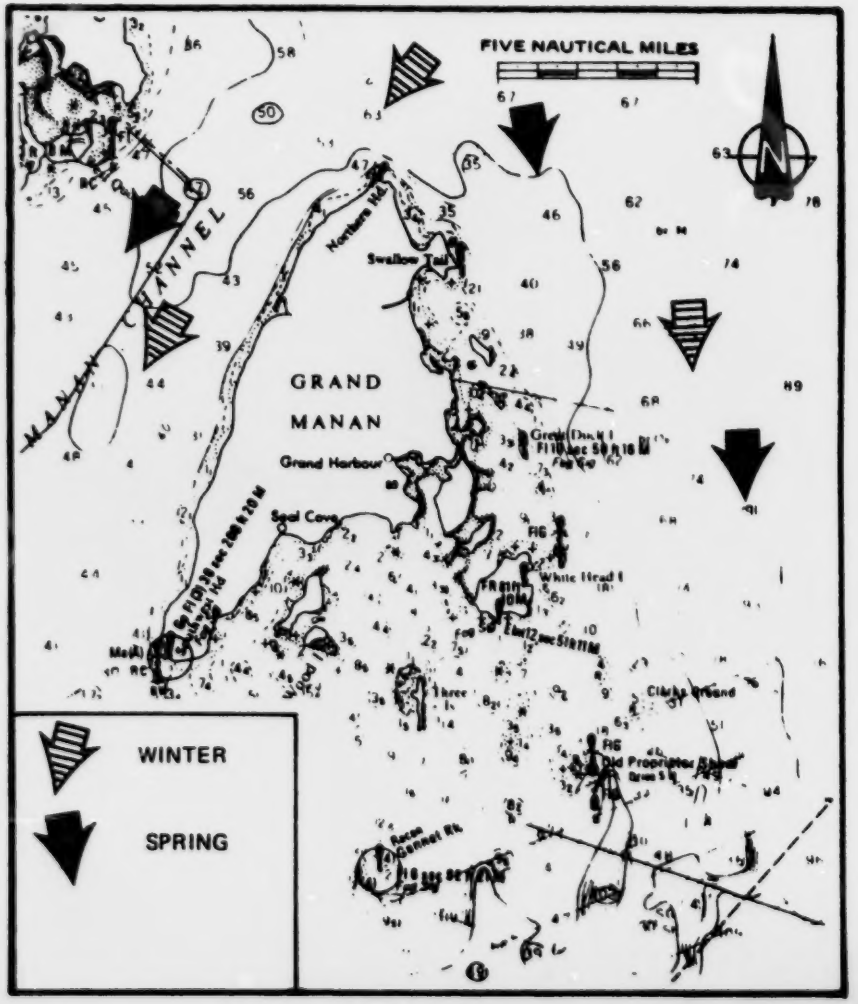
5.5.2
GENERALIZED SUMMER SURFACE CIRCULATION PATTERNS (modified after Chevrier 1959)

THE GRAND MANAN ARCHIPELAGO



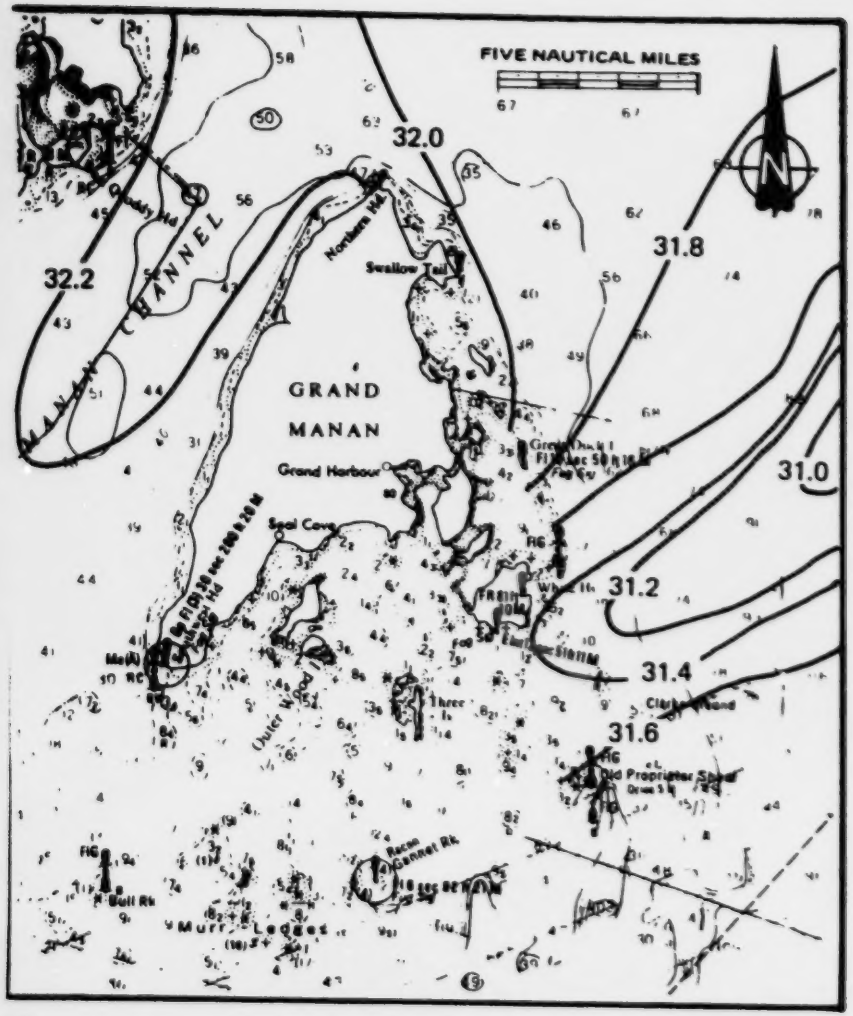
5.5.3
GENERALIZED WINTER SURFACE CIRCULATION PATTERNS (modified after Chevrier 1959).

THE GRAND MANAN ARCHIPELAGO



5.8.1
SALINITY

THE GRAND MANAN ARCHIPELAGO



6. WATER QUALITY AND POLLUTION

6.1 INTRODUCTION. On the whole, the study area has relatively pure waters and is free from continuous heavy pollution.

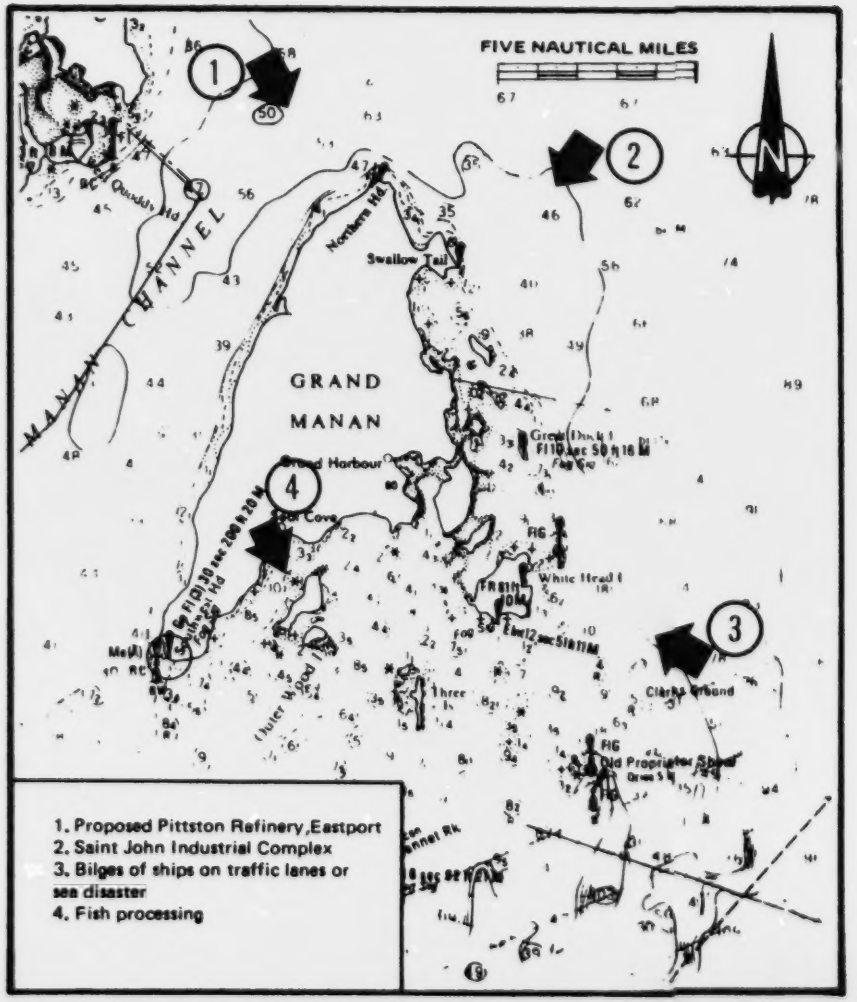
Identified sources of pollution (Figure 6.1.1) include shore-side residental waste as well as a fish processing plant located at Seal Cove.

Although there are several major sources of pollution along the New Brunswick coast, none of these directly influence the Grand Manan Archipelago. Animals within these areas, however, may carry large concentrations of such chemicals as DDT which enter the system elsewhere.

The study area may be affected by industrial development on the coast of the Bay of Fundy. There are the deepwater port facility at Lorneville with supertanker capacity, adjacent to the city of Saint John in New Brunswick and the nuclear power station at Point Lepreau, N.B., which is assumed to have the potential to attract much secondary manufacturing in its train. Construction of these two has begun. The third, the proposed Pittston Corporation Oil Refinery and Tanker Terminal for Eastport, Maine has greatly concerned environmentalists although its chance of becoming a reality is, at present, in jeopardy. Moderate oil-spills have already occurred near Saint John and residents of Grand Manan indicate that oil has, on several occasions, reached their shores, including one spill in March, 1964, which killed hundreds of seabirds (Baird, et. al., 1973).

6.1.1 POTENTIAL POLLUTION SOURCES

THE GRAND MANAN ARCHIPELAGO



7. PLANTS & ANIMALS

7. PLANTS AND ANIMALS

The following section documents the plants and animals of the study area as recorded by MRA's field staff. While not all species occurring in the area were encountered during the field survey, a large percentage were located and their distribution and abundance patterns were recorded.

Although actual numbers of many species were recorded, abundance records presented here are qualitative. In general, abundance was determined on the following basis:

PRESENT (P)	A species was considered to be "present", if it occurred only in small numbers and was usually difficult to locate.
COMMON (C)	A species was considered to be "common", if it was a common part of the flora and fauna and was easily observed and located.
ABUNDANT (A)	A species was considered to be "abundant" if it occurred in unusually large numbers and dominated the flora or fauna of a particular site.

Where Distribution and Abundance records are listed in the Annotated list of species, the transect or study site is given first followed by the abundance notation. For example, "1-A" indicates the species was abundant at site one. An abundance range (P-A) indicates that abundance varied from present to abundant depending on substrate or depth

PORIFERA
(SPONGES)

7.1 INTRODUCTION

Numerous species of sponges occur in the Bay of Fundy. A few occur intertidally but most are found subtidally from low water to depths of 100 feet and more; usually on hard substrates. Sponges were found to be a common component of the local fauna and were recorded throughout the study area.

While potential exists for the pharmaceutical utilization of chemicals extracted from certain species, there is no present commercial utilization of this group

7.2 ANNOTATED LIST OF SPECIES

7.2.1 CRUMB-OF-BREAD SPONGE/*Halichondria panacea* (Pallas)

Description - Irregular encrusting masses to 6 inches; often with erect chimney-like structures; yellow, green, purple.

Habitat - Intertidal and subtidal on rocks, shells and pilings.

Distribution and Abundance - (Figure 7.2.1) - T1-P, T2-P, T4-P, T6-P, T8-A, T9-P-C, (D) 3-P, 4-C, 5-P, 7-P, 10-P, 12-P, 13-P, 14-P, 17-P, 18-P, 19-P, 20-P, 21-P, 22-P, 27-C, 28-P, 31-P, 32-P, 35-C, 38-P, 39-C, 40-P, 42-P, 43-P, 44-P, 46-P, 47-P, (S) 6-P, 9-P, 10-P, 17-P, 21-P.

7.2.2 DEADMAN'S FINGERS/*Haliclona (Chalina) oculata* (Linnaeus)

Description - A large (to 18 inches) upright branching sponge composed of many close-set, finger - like branches supported on a single stock; brown to soft orange-red.

Habitat - Grows abundantly subtidally on pilings and rock substrate.

Distribution and Abundance - (Figure 7.2.2) - T5-P, D14-P, D16-P, D18-P, D19-C, D21-P, D31-P, D35-C, D37-P, D38-P.

DEAD-MAN'S FINGERS

7.2.3 LEUCOSOLENIA SPONGE/*Leucosolenia sp.*

Description - Colonies to 1 inch; occasionally larger. Erect, finger-like individuals arising from stolon-like tubes at base; off-white.

Habitat - Grows most commonly in shaded areas on wharves, floats and pilings; under rocks in tide pools and subtidally.

Distribution and Abundance - (Figure 7.2.3) - S17-P, 21-P.

7.2.4 UNIDENTIFIED SPONGES

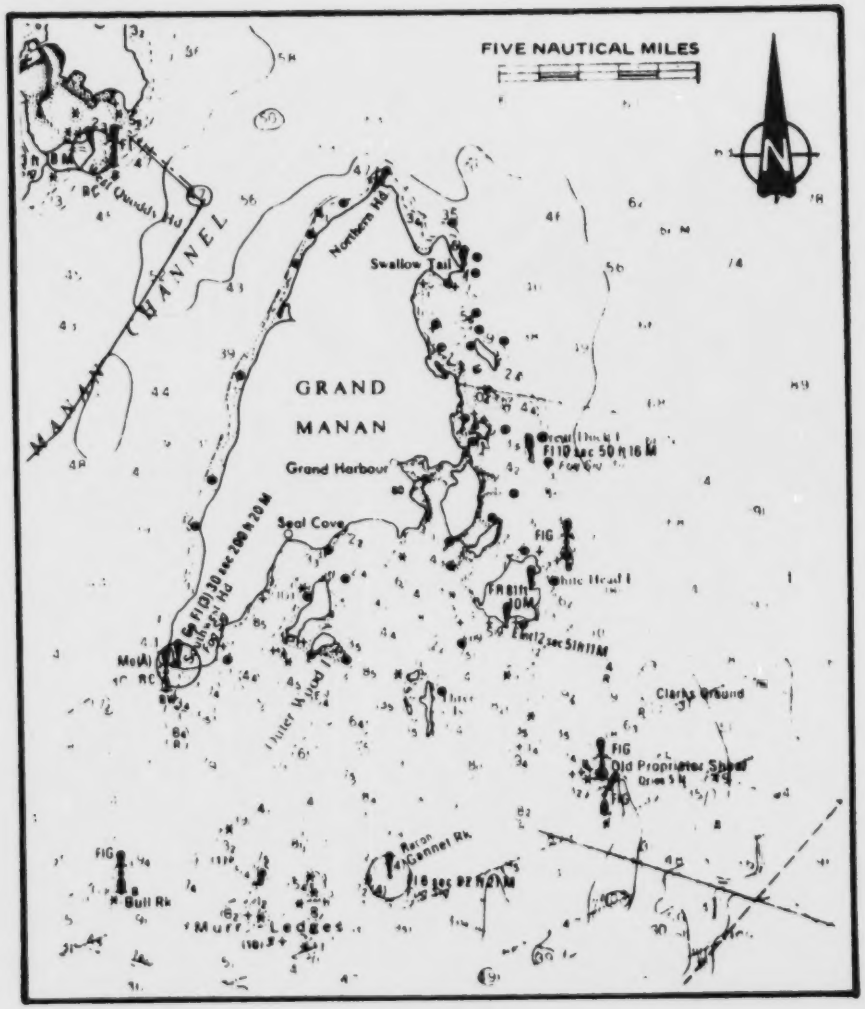
Unidentified species of sponges were recorded. Since it is difficult to identify many species on the basis of external morphology, these species were mapped together.

Tentative Identification, Distribution and Abundance (Figure 7.2.5)

Orange encrusting: S1-P, 5-P, 6-P, 23-P, (Figure 7.2.4).
Myxilla-like: D3-P, 4-C, 19-P (Figure 7.2.5).
Phakellia-like: T2-P-C, D6-P, 7-P, 18-P, 42-P, 43-C, 44-C, 46-P, 47-C (Figure 7.2.6).
Isodictya-like: D31-C.
White hairy: S6-P
Polymastia-like: D18-P.
Other species: T5-P, T6-P, D3-C, D4-C, D25-C.

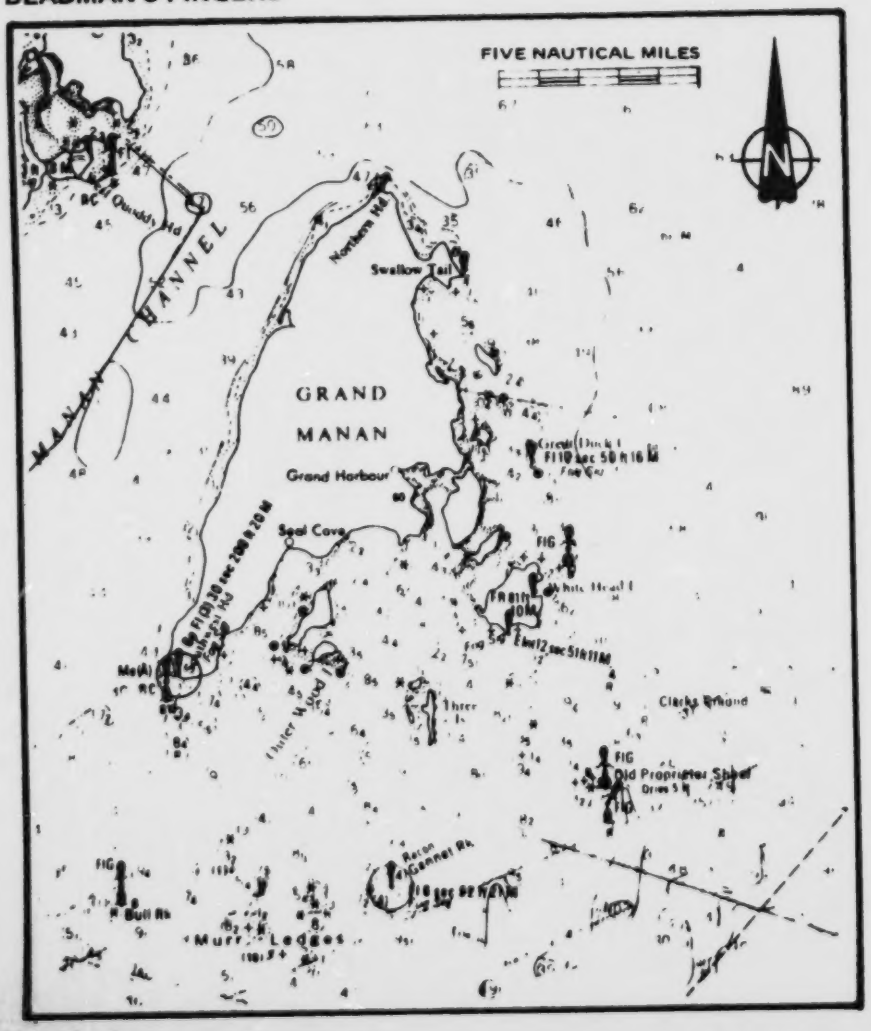
7.2.1 DISTRIBUTION OF CRUMB-OF-BREAD SPONGE

THE GRAND MANAN ARCHIPELAGO



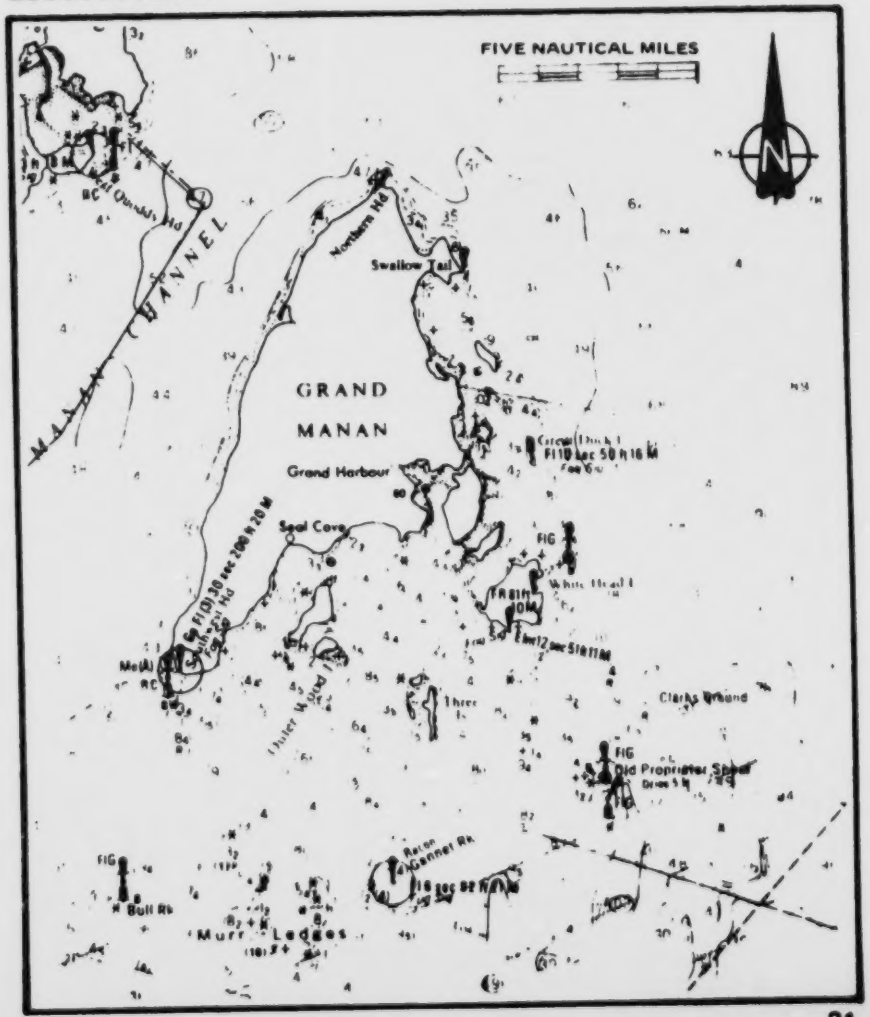
7.2.2
DISTRIBUTION OF DEADMAN'S FINGERS

THE GRAND MANAN ARCHIPELAGO



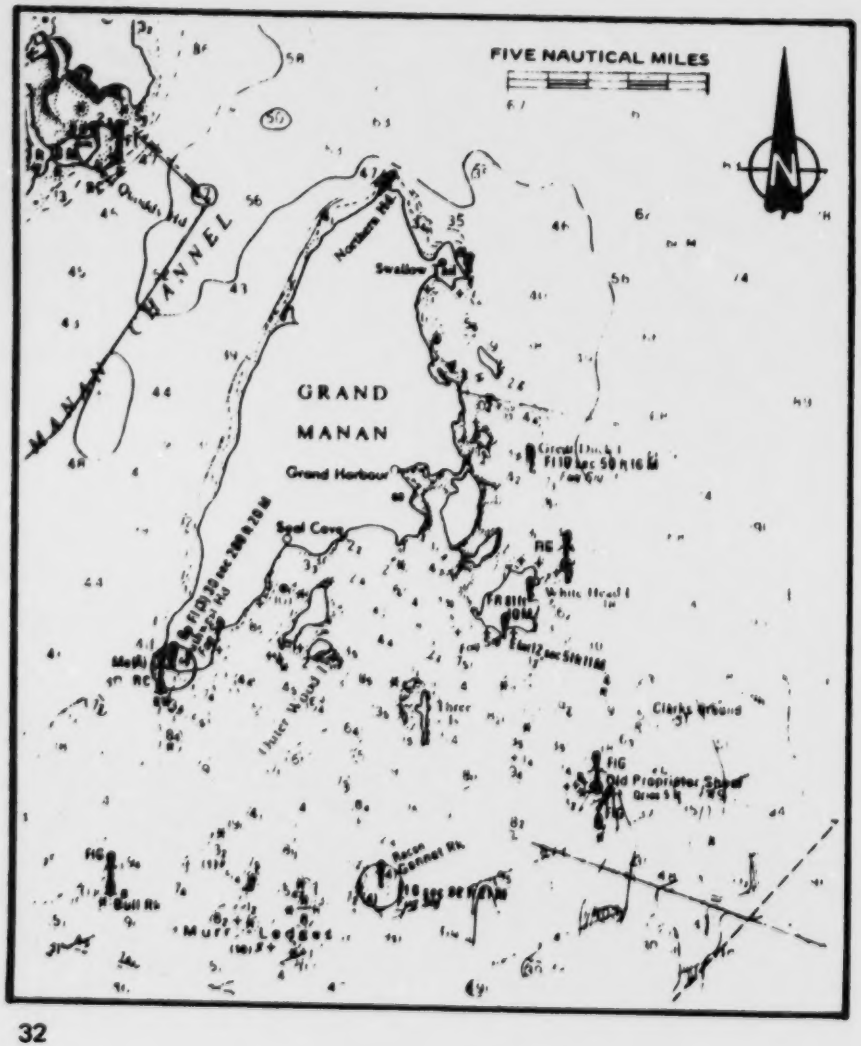
7.2.3
DISTRIBUTION OF LEUCOSOLENIA

THE GRAND MANAN ARCHIPELAGO



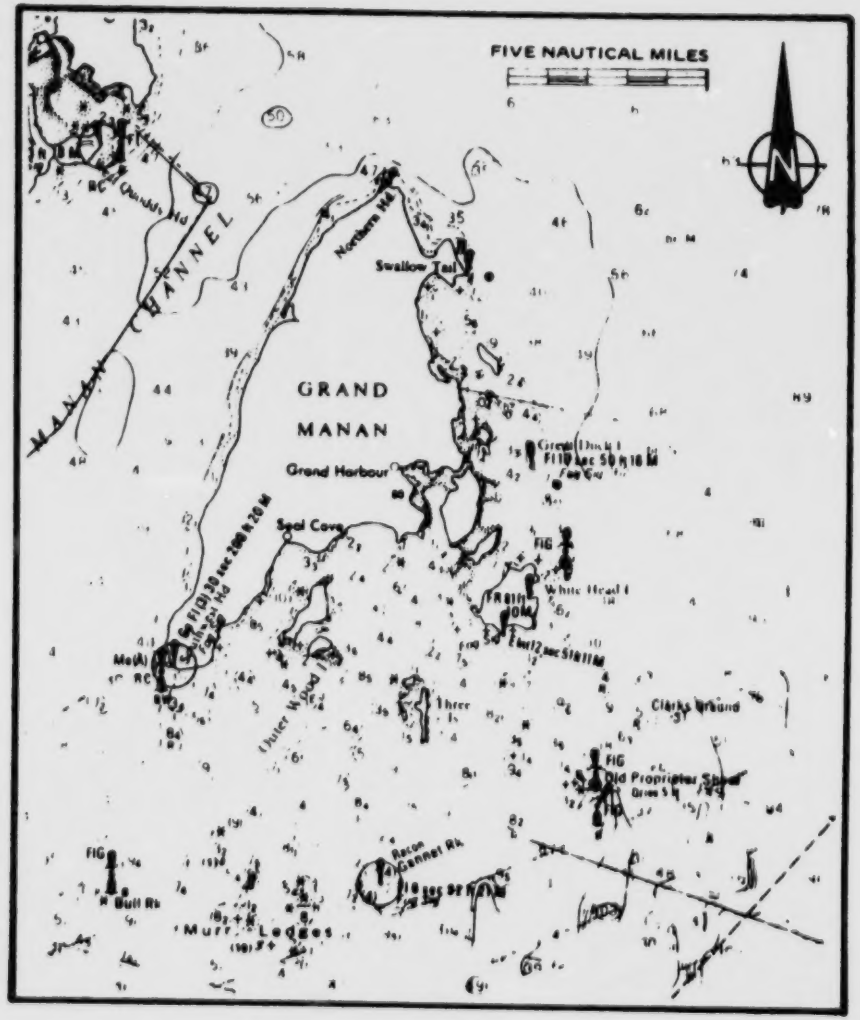
7.2.4
DISTRIBUTION OF ORANGE ENCRUSTING SPONGE

THE GRAND MANAN ARCHIPELAGO



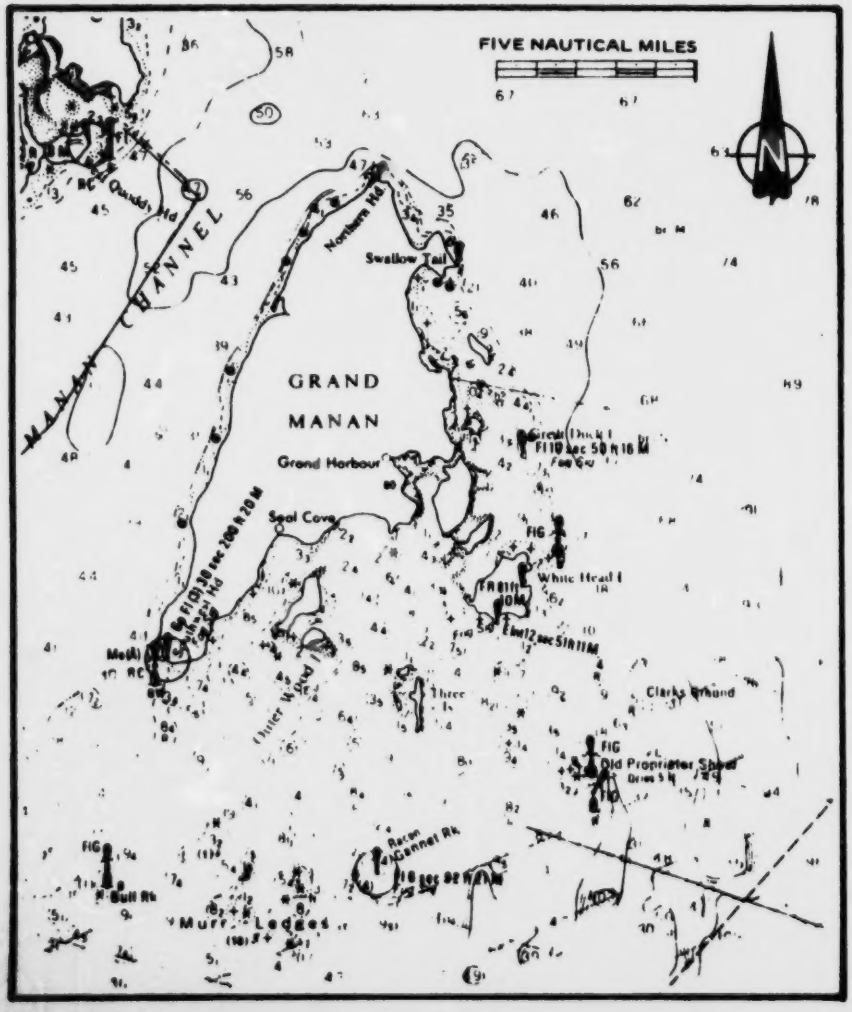
7.2.5
DISTRIBUTION OF MYXILLA-LIKE SPONGE

THE GRAND MANAN ARCHIPELAGO



7.2.6
DISTRIBUTION OF PHAKELLIA-LIKE SPONGE

THE GRAND MANAN ARCHIPELAGO



CNIDARIA
CTENOPHORA
(JELLYFISH, ANEMONES, ETC.)
(COMB JELLIES)

7.3 INTRODUCTION

Hydroids, jellyfish, sea anemones, soft corals and other Cnidarians form an important part of the fauna of the Bay of Fundy. Most species are either subtidal or free-floating. A few, principally certain anemones and hydroids, occur intertidally; mainly in tide pools.

There is no known commercial use for Cnidarians. Nevertheless, the Moon Jellyfish (*Aurelia aurita*) occasionally occurs in extremely large numbers during the summer. At such times, this species may cause structural damage to local herring weirs due to numerous Jellyfish restricting water flow through the netting. Resistance may cause tearing of the twine and, occasionally, collapse of supporting pilings.

7.4 ANNOTATED LIST OF SPECIES

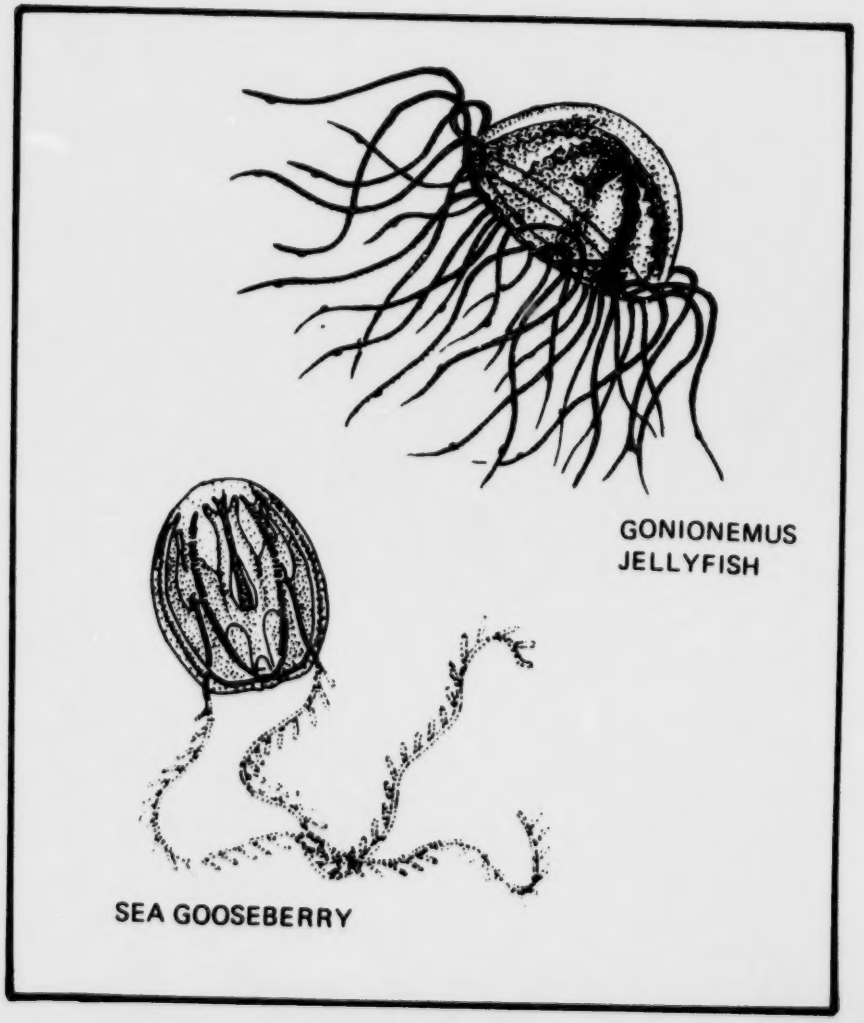
HYDROIDS

7.4.1 HYDROID/*Obelia sp.*

Description - There are several different species of *Obelia*. Some form dense branching colonies up to 10 inches in length. The tiny *Obelia geniculata* appears to be the most common species in the study area. *O. geniculata* reaches a maximum size of about 1 cm. Under a microscope it can be seen that the polyp bearing branches arise alternately from a single stalk. Color is white.

Habitat - *O. geniculata* was found commonly on the undersurface of subtidal rocks and on kelp.

Distribution and Abundance - (Figure 7.4.1) - T2-P, (D) 3-A, 4-C, 5-A, 11-C, 13-A, 14-P, 18-P, 19-A, 31-C, 35-C, 38-A, 39-A, 42-P, 43-P, 44-C, 45-P, 46-P, 47-P; (S) 26-P.



7.4.2 PINK-HEARTED HYDROID/*Tubularia sp.*

Description - This hydroid usually occurs in clusters composed of several to dozens of individuals. Polyps are small but visible to the naked eye and occur singly on a 6 cm. stalk. Color - polyps are pink, stalks white.

Habitat - This species occurs most abundantly, subtidally, on pilings, wharves and weir twine, It also occurs commonly, in some areas, on rocky bottom. It is common to abundant on such habitat in the study area.

Distribution and Abundance - (Figure 7.4.1) - (D) 4-C, 5-P, 6-P, 14-P, 18-P, 19-C, 37-P, 39-P-C.

7.4.3 HYDRACTINIA HYDROID/*Hydractinia echinata* Fleming

Discription & Habitat - Polymorphic individuals growing on Mollusc shells inhabited by hermit crabs.

Distribution and Abundance - (Figure 7.4.1) - D14-P.

7.4.4 NODDING NOSEGAY/*Corymorpha pendula* Agassiz

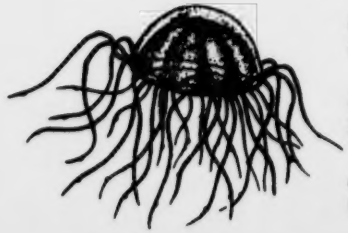
Description - This is our largest solitary hydroid, reaching a height of 5 to 7 cm. Attached to the bottom by a root-like hold-fast. Color-Translucent, pink and white.

Habitat - Occurs most commonly, subtidally on sand and muddy sand; less commonly on mud.

Distribution and Abundance - (Figure 7.4.1) - T5-P, D4-P-C, D8-P, D9-C, D12-P-A.

JELLYFISH

7.4.5 GONIONEMUS JELLYFISH/*Gonionemus murbachii* Mayer



Description - A small (less than 1") delicate medusa with gonads forming a cross.

Habitat - At Grand Manan, found in 10 to 20 feet of water attached to kelp.

Distribution and Abundance - D10-C, D11-C.

7.4.6 MOON JELLYFISH/ *Aurelia aurita* (Linnaeus)

Description - This is the common Fundy Jellyfish. Reaching a foot or more in diameter when mature, it is easily distinguished by its form and four circular gonad rings. Color-transparent and white.

Habitat - Free swimming as Jellyfish. Overwintering scyphistoma occur under rocks subtidally and in tide pools and under wharves and floats.

Commercial Importance - As previously mentioned, large numbers of this species may cause damage to weirs.

Distribution and Abundance - Not recorded during this survey but common in these waters in summer.

7.4.7 RED ARCTIC JELLYFISH/*Cyanea capillata* (Linnaeus)

Description - This large (to 50 cm) Jellyfish is distinguished by a massive red and brown body and long trailing tentacles. Some people react to the sting of this species.

Habitat - Free-swimming medusae are usually rare in this area. However, in some years they occur in fairly large numbers during the summer months.

Distribution and Abundance - Not recorded during this survey but present at irregular intervals in these waters.

7.4.8 STAUROMEDUSA/*Lucernaria sp.*

Description - Stauromedusae are sessile Jellyfish usually found attached to subtidal rock or kelp by a single stalk.

Distribution and Abundance - D42-P-C, D22-P.

Unidentified sp. - D7-C-A, D13-C.

Haliclystis - T6-P.

ANEMONES

7.4.9 COMMON ANEMONE/*Metridium senile* (Linnaeus)

Description - This is the Common Fundy Anemone. It has typical anemone form and reaches 20 cm in height. Color varies from white, brown, red, orange, occasionally mottled.

Habitat - Common subtidally on pilings, weirs, floats, wharves and rocky substrate. Small individuals are occasionally found in tide pools.

Distribution and Abundance - (Figure 7.4.2) - T2-P-C, D3-P, D4-C, D12-P, D14-P, D18-P, D19-A, D43-P, D44-C, D45-P, D47-P, S1-P, S21-P.

7.4.10 DAHLIA ANEMONE/*Tealia felina* (Linnaeus)

Description - This is a large colorful anemone reaching 15 cm in diameter. It is characterized by many thick tentacles and bright red color with distinctive white markings.

Habitat - Occurs most commonly, subtidally, on ledges and rocks; less commonly on pilings, floats and wharves.

Distribution and Abundance - (Figure 7.4.2) - T1-P, T2-P-C, D3-P, D4-P, D19-P, D39-C, D43-P, D44-P, D45-P, D46-P, D47-C.

7.4.11 BURROWING ANEMONE/*Cerianthus borealis* (Verrill)

Description - Commonly referred to as "sloppy guts" this large (25 cm) burrowing anemone secretes a grey gelatinous tube in which it lives. The animal itself is light brown with large tentacles striped with green.

Habitat - Subtidally in sand, muddy sand and loose bottom. Usually in deep water.

Distribution and Abundance - Figure 7.4.2) - D4-C.

7.4.12 BURROWING ANEMONE/*Edwardsia sipunculoides*

Description, Habitat and Abundance - This small intertidal species occurs in sand and muddy sand. Observed at only one site - T4-P.

SIPHONOPHORES

7.5 SIPHONOPHORE/*Cupulita cara*

Description, Habitat, Distribution and Abundance -Siphonophores include By-the-wind Sailors and Portuguese Man-of-war. Locally this group is represented by a single species, *Cupulita cara.* This is a free-swimming animal which occurs as long string-like colonies growing to 50 cm or more. This species occurs abundantly in surrounding waters at irregular intervals. Observed at D19-P.

COMBJELLIES

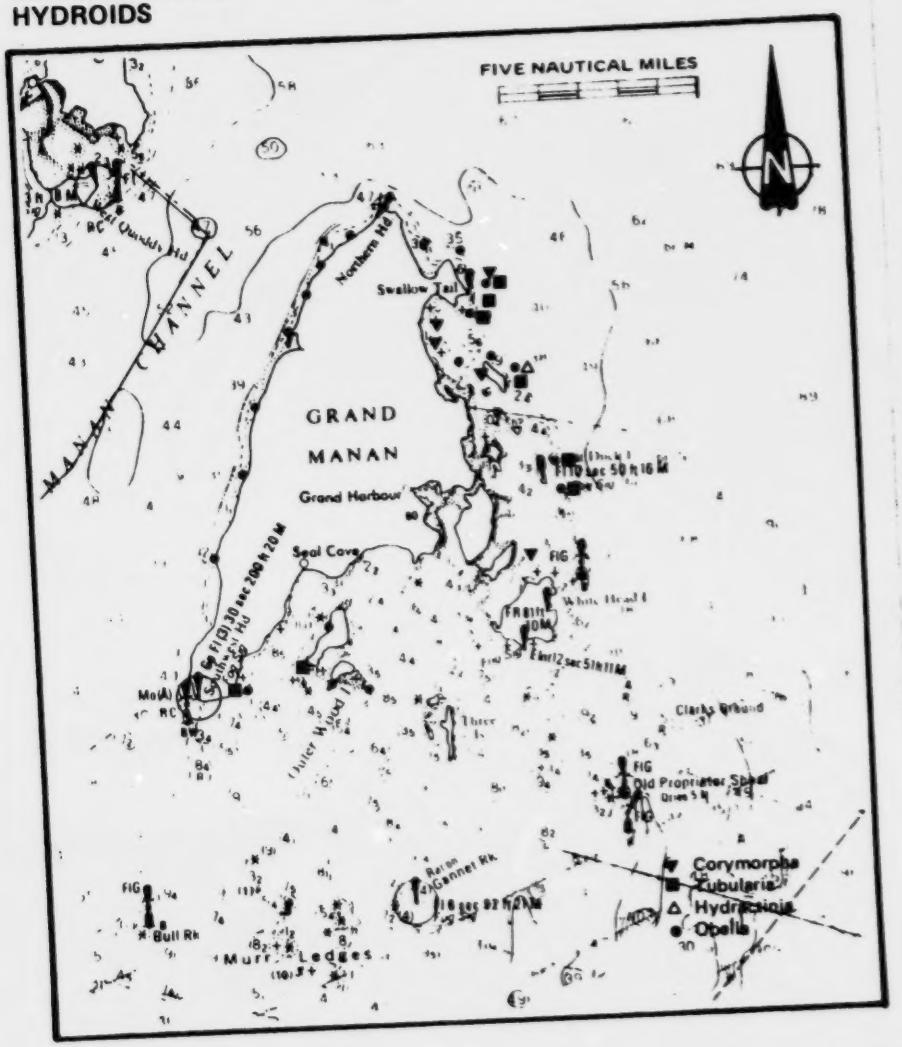
7.6 COMBJELLIES/*Beroe cucumis* Fabricius

Description, Habitat, Distribution and Abundance - Comb-jellies are small free-swimming animals which occur abundantly in the area at irregular intervals. Species which occur in the area include: *Pleurobrachia pileus* (Fabricius), *Mertensia ovum* (Fabricius), *Bolinopsis infundibulum* Müller, *Bolina alata* Agassiz and *Beroe cucumis.*
Beroe observed - D7-P (Figure 7.6.1).

Pleurobrachia pileus - D21-P, D29-C, D35-P, D37-P, D41-C, D44-A, S25-P (Figure 7.6.1).

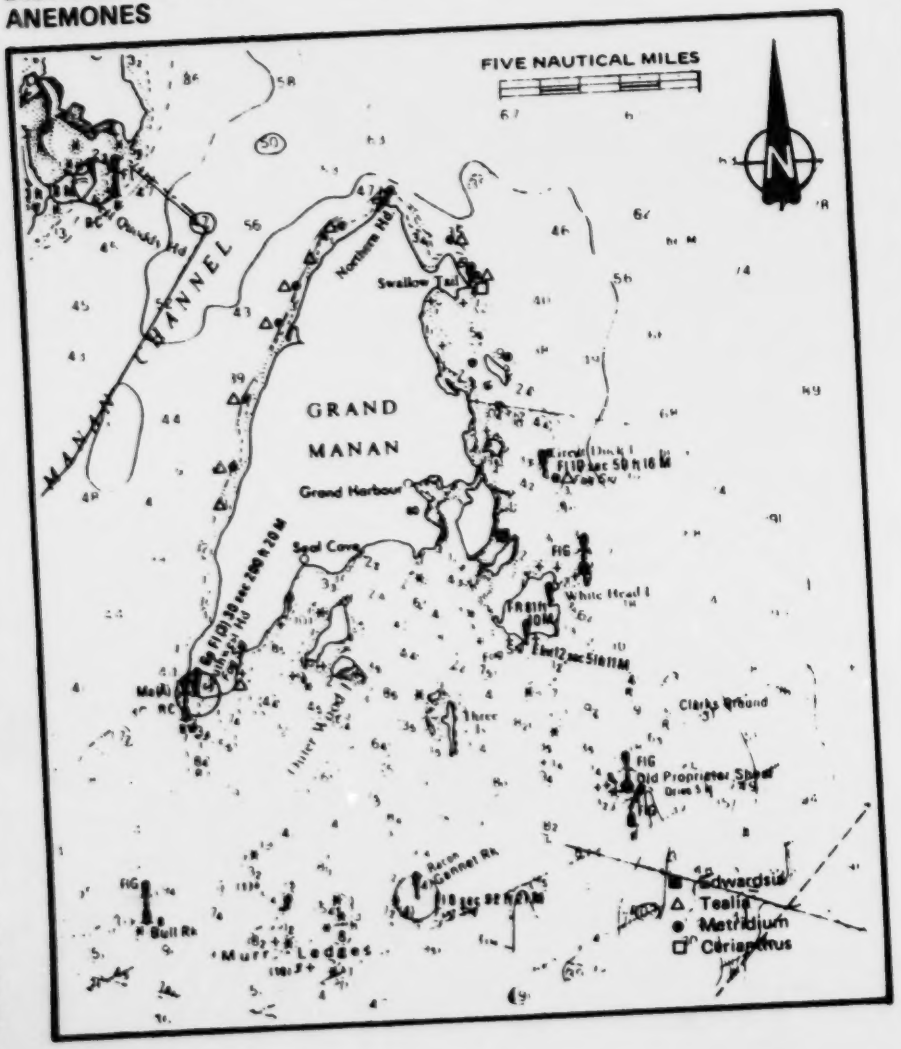
7.4.1
DISTRIBUTION OF HYDROIDS

THE GRAND MANAN ARCHIPELAGO



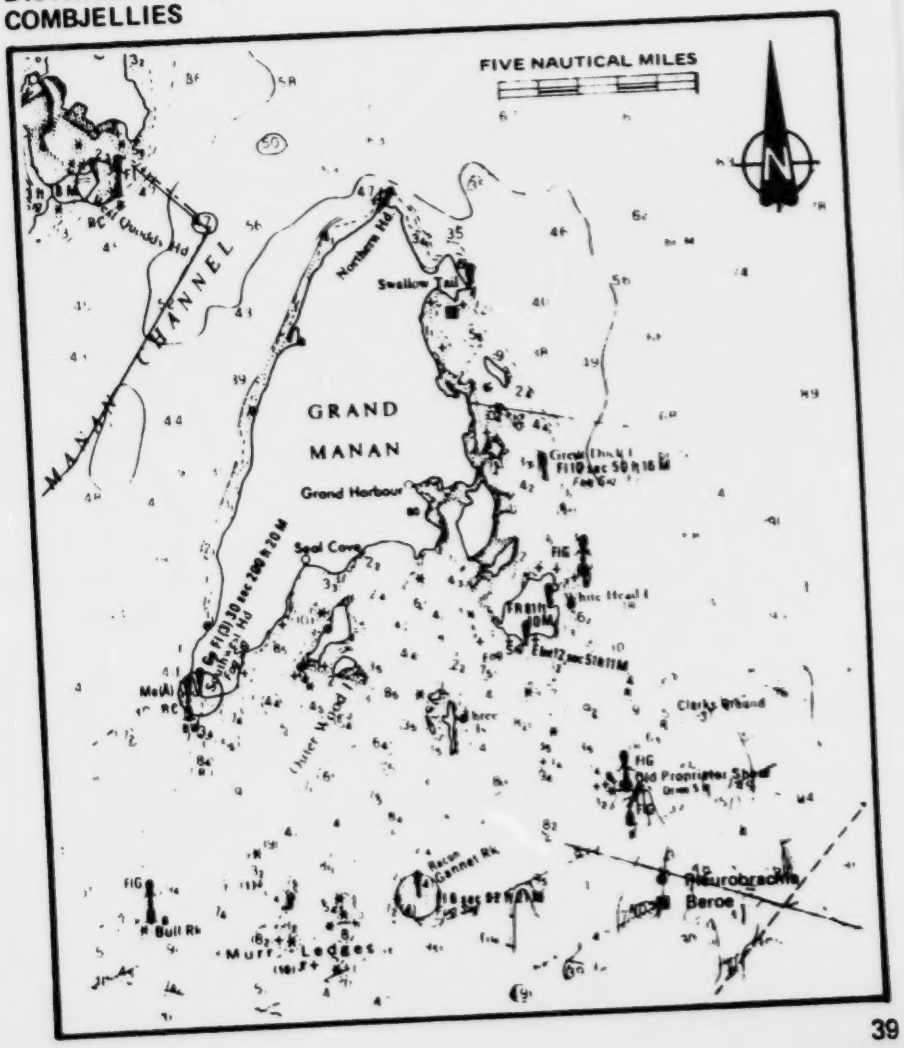
7.4.2
DISTRIBUTION OF ANEMONES

THE GRAND MANAN ARCHIPELAGO



7.6.1
DISTRIBUTION OF COMBJELLIES

THE GRAND MANAN ARCHIPELAGO



ECTOPROCTA
BRACHIOPODA
(MOSS ANIMALS & BRACHIOPODS)

BRYOZOANS

7.7 MOSS ANIMALS/*Bryozoans*

General - Bryozoans are of diverse, widespread and abundant occurrence in the study area. They occur intertidally but most commonly subtidally. Species identification is difficult and time consuming and was beyond the scope of this study. Nevertheless, general distribution and abundance was recorded.

Distribution and Abundance

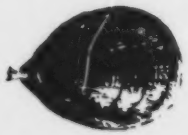
Erect Branching - (Figure 7.7.2) - T1-P, T2-P, T4-C, T5-C, T7-A, D2-A, D3-C, D4-C-A, D5-P, D6-P, D14-P, D15-P, D16-P, D17-C, D18-C, D19-A, D20-A, D21-P, D22-P, D29-P, D31-A, D35-C, D38-A, D39-A, D46-P, D47-P, S1-P, S2-P, S4-P, S10-P, S13-P, S14-P, S21-P-A, S24-C, S26-P.

Encrusting Species - (Figure 7.7.1) - T1-P, T2-P, T4-C, T5-C, T7-A, D2-A, D3-C, D5-P, D6-P, D13-P, D14-P, D15-P, D16-P, D17-P, D18-C, D19-A, D20-P, D21-P, D22-P, D29-P, D38-A, D39-A, D40-A, D46-C, D47-P, S1-P, S5-P, S9-P, S10-P, S14-P, S17-C, S21-C, S26-C.

Flustrellidra hispida - (Figure 7.7.3) - D2-A, D3-C, D4-P, D5-P, D14-P.

BRACHIOPODS

7.8 ATLANTIC BRACHIOPOD/*Terebratulina septentrionalis* (Couthouy)

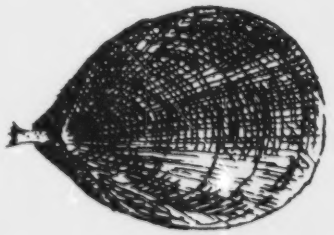


General - Brachiopods are a primitive group of bivalve-like animals which are represented by only one species (*T. septentrionalis)* in the Bay of Fundy.

Description - Small (2 cm); 2 valves; attached to the substrate by a short stalk emerging from the hinge.

Habitat - From low water to depths in excess of 100 feet. Found on rock substrate. In shallow water this species occurs under rocks and overhangs. In deep water it occurs on the uppermost surfaces of rocks and ledges. It is common on typical habitat in the study area.

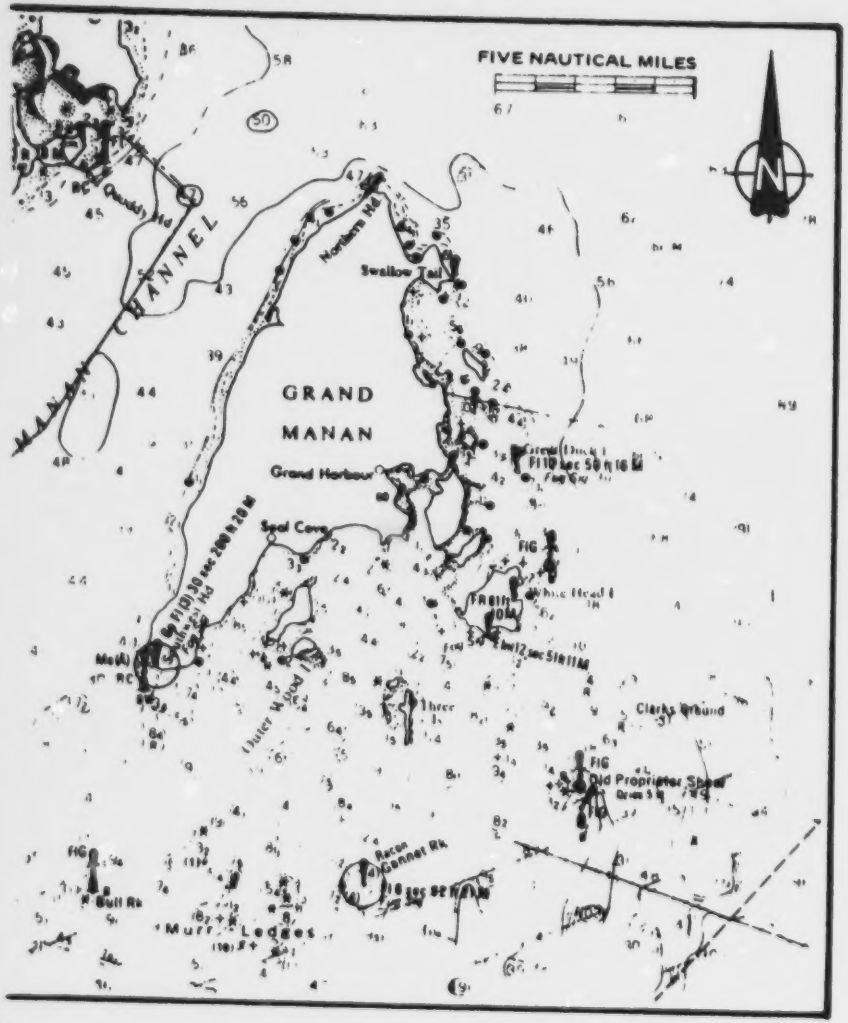
Distribution and Abundance - (Figure 7.8.1) - T1-C, T2-C, T4-P, D3-P, D4-C, D6-P, D14-P, D16-P, D19-C, D40-P, D44-C, D47-C.



ATLANTIC BRACHIOPOD

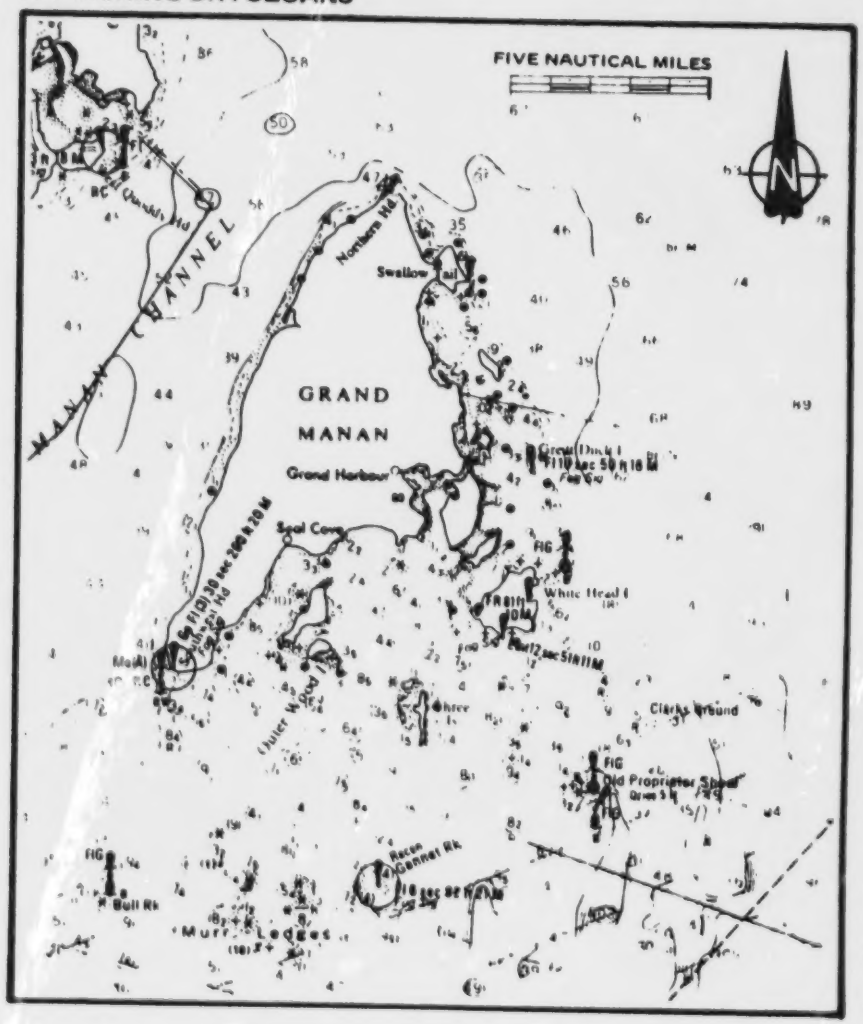
7.7.1
DISTRIBUTION OF ENCRUSTING BRYOZOANS

THE GRAND MANAN ARCHIPELAGO



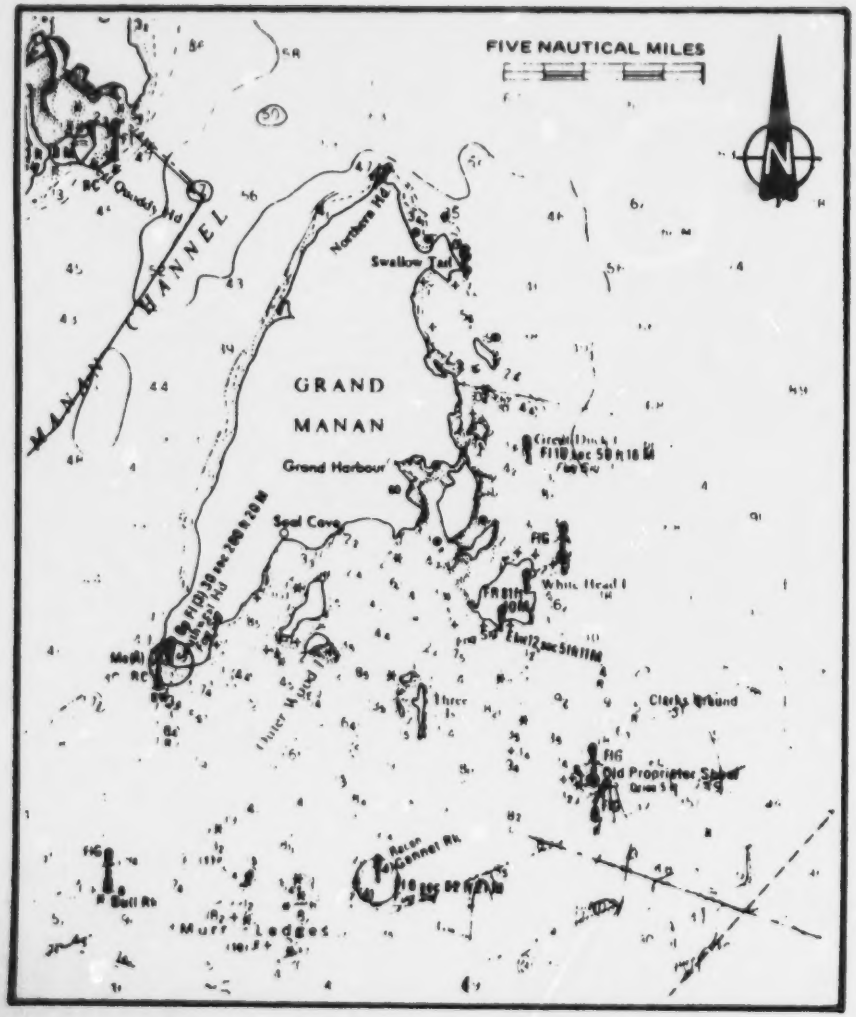
7.7.2
DISTRIBUTION OF ERECT BRANCHING BRYOZOANS

THE GRAND MANAN ARCHIPELAGO



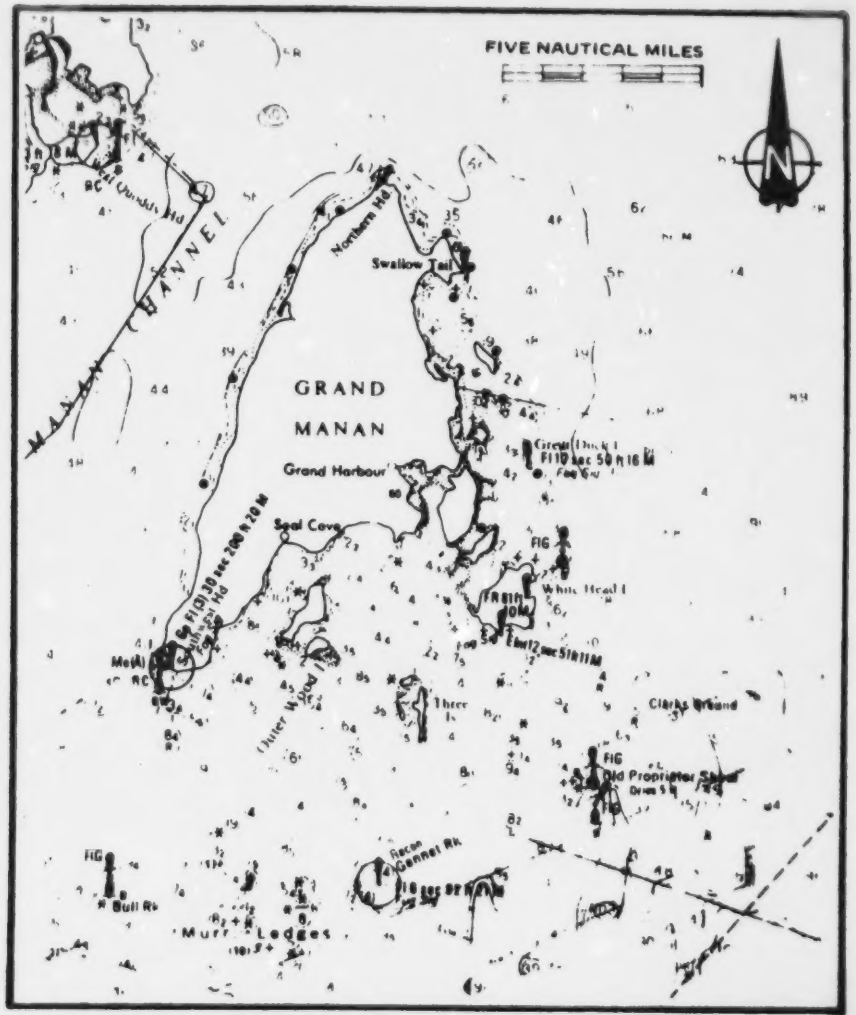
7.7.3
DISTRIBUTION OF FLUSTRELLIDRA

THE GRAND MANAN ARCHIPELAGO



7.8.1
DISTRIBUTION OF THE ATLANTIC BRACHIOPOD

THE GRAND MANAN ARCHIPELAGO



MOLLUSC
(CLAMS, SNAILS, SLUGS, SQU

7.9 INTRODUCTION

Clams, snails, nudibranchs and other molluscs form one of the most diverse and common groups in the Bay of Fundy. They occur everywhere, from high water to great depths, and on virtually every substrate.

Many species are important commercially or have potential for commercial utilization.

7.10 ANNOTATED LIST OF SPECIES

CHITONS AND LIMPETS

7.10.1 COMMON LIMPET/*Acmaea testudinalis* (Muller)

Description - This small (3 cm) cone-shaped mollusc clings to rock surfaces by a well developed muscular foot. Color-dull cream, bluish grey, irregular bars.

Habitat - Occurs commonly on rock surface intertidally above low water and to 30 or 40 feet subtidally.

Distribution and Abundance - (Figure 7.10.1) - T1-C, T2-C, T4-P-C, T5-C, T6-P, T7-P, T8-P-C, T9-P, D1-C, D3-C, D4-P, D5-C, D7-C, D10-A, D11-P, D13-P, D14-C, D16-P, D17-P, D19-C, D20-P, D21-P, D29-C, D31-P-C, D36-P, D38-P, D39-P, D40-P-C, D41-C.

7.10.2 RED CHITON/*Ischnochiton ruber* (Linnaeus)

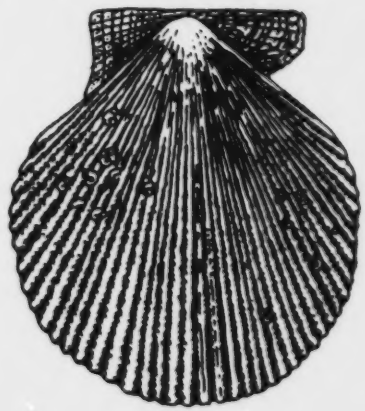
Description - A small (2.5 cm) clinging mollusc characterized by rows of dorsal plates. Color-red, mottled.

Habitat - Occurs on rock from low water to 100 feet and more.

Distribution and Abundance - (Figure 7.10.2) -

I. ruber - T1-P, T2-P, T4-A, T5-P-A, T6-P, T8-C, D2-A, D3-C, D4-C, D5-C, D7-C, D10-C, D12-A, D13-C, D14-P, D15-P, D16-P, D17-C, D19-P, D20-P, D21-P, D22-P, D27-C, D29-C, D32-P, D38-P, D39-C, D40-P, D43-C, D44-P, D45-C, D46-P, D47-P, S1-P, S11-A, S17-P.

I. alba - T4-C, D5-C, D10-C, D20-P, D38-P, S21-P.



ICELAND SCALLOP

TEN-RIDGED WHELK

7.10.3 COMMON PERIWINKLE/*Littorina littorea* (Linnaeus)

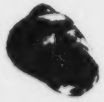
Description - A small (3 cm) snail of typical form. Brownish with grey black bands.

Habitat - Occurs intertidally on all substrates. Found in shallow subtidal areas in some localities.

Commercial Utilization - This species is gathered commercially in some areas of the Bay of Fundy.

Distribution and Abundance - (Figure 7.10.3) - T9-P, D24-P, D25-C, S1-C, S2-P, S3-C, S4-P-C, S5-P, S6-P, S7-P, S8-P, S9-P, S10-P, S12-C, S13-P, S14-P, S16-P, S17-P, S18-P, S19-P, S21-C, S22-P, S23-P, S24-P, S26-P.

7.10.4 SMOOTH PERIWINKLE/ *Littorina obtusata* (Linnaeus)



Description - A small (to 13 mm) periwinkle with a smooth, shiny shell; brownish-yellow to dark brown; occasionally banded.

Habitat - Intertidal on rocky shores.

Distribution and Abundance - (Figure 7.10.4) - T5-C, D52-P, S4-P-C, S8-P-C, S9-P, S10-P, S11-P, S12-P-C, S13-P, S15-P, S19-C, S24-C, S25-C, S26-P.

7.10.5 ROUGH PERIWINKLE/*Littorina saxatilis* (Olivi)

Description - A small (to 13 mm) periwinkle; grey to dark brown; sometimes mottled with yellow, brown or black

Habitat - Upper intertidal area of rocky shores.

Distribution and Abundance - (Figure 7.10.5) - S1-C, S2-P, S4-P-C, S8-P-C, S6-P, S9-P, S10-P, S11-C, S12-P-C, S13-P, S14-P, S15-P, S17-P, S18-P, S19-C, S22-P, S23-P, S25-P, S26-P.

7.10.6 TEN–RIDGED WHELK/*Neptunea decemcostata* (Say)

Description - A large (11 cm) snail characterized by prominent ridges. Color-light tan.

Habitat - Occurs subtidally on rock, sand and mixed substrate.

Commercial Utilization - While this snail is considered edible, its limited abundance and limited marketability probably preclude utilization.

Distribution and Abundance - (Figure 7.10.6) - T4-P, T5-P, T9-P, D3-P, D4-P, D5-P, D14-P, D35-P, D36-P, D37-P, S22-P.

7.10.7 NORTHERN WHELK/*Buccinum undatum* Linnaeus

Description A large (10 cm) snail. Color yellowish brown.

Habitat - Occurs subtidally on rock, mud, sand and mixed substrate.

Commercial Utilization - This is an edible snail with limited acceptance. While of widespread occurrence abundance is low and potential for a fishery appears poor.

Distribution and Abundance - (Figure 7.10.7) - T3-P, T4-P, T5-P, T6-P, T8-P, T9-P, D7-P, D10-P, D12-P, D13-C, D14-P, D16-P, D17-P, D20-P, D29-A, D31-P-C, D39-P, D40-P, D41-P, D46-P, S1-P, S8-P, S23-P.

7.10 8 STIMPSON'S WHELK/*Colus stimpsoni* (Morch)

Description A large (10 cm) spindle shaped snail. Color-white and brown.

Habitat Occurs subtidally on rock, sand and mixed substrate.

Commercial Utilization While this snail is considered edible, low population size and limited market acceptance precludes commercial utilization

Distribution and Abundance - Figure 7.10.6) - T9-P, D3-P, D5-P, D13-P, D33-P, D35-P S22-P

7.10.9 LORA/*Oenopota (Lora) elegans* (Muller)

Description - A small (up to 21 mm) gastropod. White to light brown.

Distribution and Abundance - (Figure 7.10.6) - D41-P.

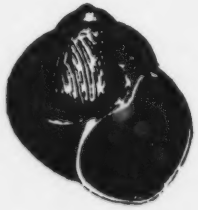
7.10.10 DOG WHELK/*Thais lapillus* (Linnaeus)

Description - A small (to 46 mm) snail characterized by a highly sculptured shell.

Habitat - Common intertidally, particularly on rocky shores where its egg capsules are commonly found under rocks.

Distribution and Abundance - (Figure 7.10.8) - T4-P, T5-P-C, T9-P, D3-P, D13-P, D36-P, S1-C, S2-P, S3-C, S4-P, S5-P, S6-P, S8-P, S10-P, S11-P, S13-P, S24-P, S26-P.

7.10.11 MOON SNAIL/*Lunatia heros* (Say)



Description - Large circular snail reaching 10 cm Color is white and grey.

Habitat - Occurs intertidally and subtidally on sand and muddy sand bottom.

Distribution and Abundance - (Figure 7.10.9) - D9-P, S8-P, S9-P, S12-P, S15-P.

7.10.12 TOPSHELLS/*Margarites costalis* (Gould)
M. groenlandicus (Gmelin)

Margarites costalis

Margarites groenlandicus

Description - Small (1 cm) typical snails. Color-pink, iridescent; white and pearly.

Habitat - Occurs subtidally on rock and kelp.

Distribution and Abundance - T4-C, T1-C, D40-P-C.

7.10.13 NUDIBRANCHS/*Coryphella sp, Aeolidia papillosa* (Linnaeus), *Onchidorus sp, Dendronotus frondosus* Ascanius, etc.

Aeolidia

Coryphella

Dendronotus

Onchidorus

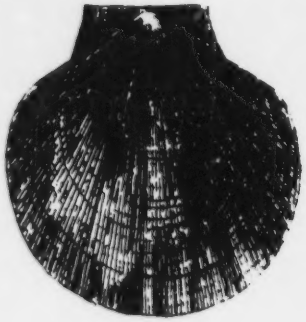
Description - This group resemble terrestrial slugs. Form varies as shown in the accompanying drawings.

Habitat - Most commonly found subtidally on rocky substrate organisms, particularly near hydroids on which many species feed. Some species occur in tide pools.

Distribution and Abundance - (Figure 7.10.10)
Coryphella sp. T9-P, D42-P, D43-P, D44-P, D46-P.
Onchidorus sp. D22-P.
Dendronotus frondosus - D15-P, D31-P.

BIVALVES

7.10.14 GIANT SEA SCALLOP/*Placopecten magellanicus* (Gmelin)



Description - A large bivalve reaching 20 cm in diameter. Color-brown tan upper valve, and whitish bottom valve.

Habitat - Occurs subtidally on sand, sandy mud and mixed bottoms.

Commercial Utilization - This species is fished commercially in the study area. See the section on the fishery for further information.

Distribution and Abundance - (Figure 7.10.11) - D4-P, D12-P,

7.10.15 JINGLE SHELL/*Anomia simplex* d'Orbigny

Description - A flattened irregular oval; smooth, thin valves; whitish.

Habitat - Common subtidally on stones, shells and kelp.

Distribution and Abundance - (Figure 7.10.11) - D31-P, S10-P.

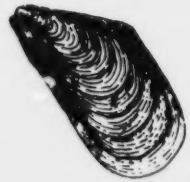
7.10.16 OCEAN QUAHOG/*Arctica islandica* (Linnaeus)

Description - A large (138 mm) ocean clam. Young are white with yellowish-brown periostracum; brown or black in adults.

Habitat - Occurs subtidally in sand.

Distribution and Abundance - D37 - P

7.10.17 BLUE MUSSEL/*Mytilus edulis* Linnaeus



Description - An elongated bivalve reaching 8 cm. Color-dark blue and black.

Habitat - Most common on rock substrate near low water.

Commercial utilization - Blue mussels are abundant in the study area and may have commercial potential.

Distribution and Abundance - (Figure 7.10.12) - T2-P, T5-A, T6-C, T9-P-A, D13-C-A, D17-P, D21-P, D25-C, D26-P. D31-C, D47-P, S1-P, S2-P, S3-C, S4-P, S5-P, S6-P-A, S8-P-C, S9-P-C, S11-P, S12-P, S13-P, S14-P, S15-P, S 17-P, S19-P, S22-P, S24-C, S26-P.

7.10.18 HORSE MUSSEL/*Modiolus modiolus* (Linnaeus)

Description - This is a large (16 cm) bivalve resembling the blue mussel. Color - bluish black.

Habitat - Occurs most commonly subtidally attached to rocky substrates. Occasionally found buried in mud and sand in tide pools and near low water.

Commercial Utilization The adductor muscle of this species is edible and marketable Potential exists for harvesting by divers.

Distribution and Abundance - (Figure 7.10.13) - T1-P, T2-P-C, T4-C,, T5-P-C, T6-P, T7-P, T8-A, D3-C, D4-C, D5-C, D6-C, D7-C, D12-C, D13-C, D14-P, D15-P, D16-P, D17-C D18-C, D19-C, D21-P, D22-C, D29-P, D31-P, D39-C, D40-P, D43-C, D44-P, D47-P, S1-P, S23-P.

7.10.19 ASTARTE/*Astarte sp.*

Description - A small (32-38 mm) yellowish-brown clam distinguished by prominent concentric ridges following the shape of the shell.

Habitat - Common subtidally in sand, muddy-sand and firm mud substrates.

Distribution and Abundance - D41-P.

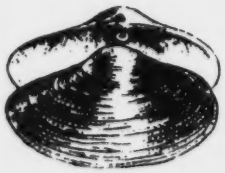
7.10.20 NORTHERN HEART SHELL/*Venericardia borealis* (Conrad)

Description - Up to 38 mm. Color-greyish white. Valves have distinct rays running from the hinge to the outer margins.

Habitat - Common subtidally in sand, muddy-sand and firm mud substrates.

Distribution and Abundance - T5-C, D7-P.

7.10.21 SOFT-SHELLED CLAM/*Mya arenaria* Linnaeus



Mya arenaria

Description - A plain white clam reaching 8 cm.

Habitat Occurs intertidally in mud, muddy sand and sand.

Commercial Utilization - This is an important commercial species harvested from the study area.

Distribution and Abundance - Figure 7.10.14) - S4-P, S5-P, S8-P, S9-P-C, S11-P, S12-P-C, S14-C, S15-C, S16-P-C, S17-P-C, S18-P, S19-C.

7.10.22 MACOMA/*Macoma balthica* (Linnaeus)

Description - A small (25 mm) oval clam; whitish.

Habitat - Common intertidally in mudflats.

Distribution and Abundance - (Figure 7.10.14) - S14-P.

7.10.23 MUSCULUS/*Musculus sp.*

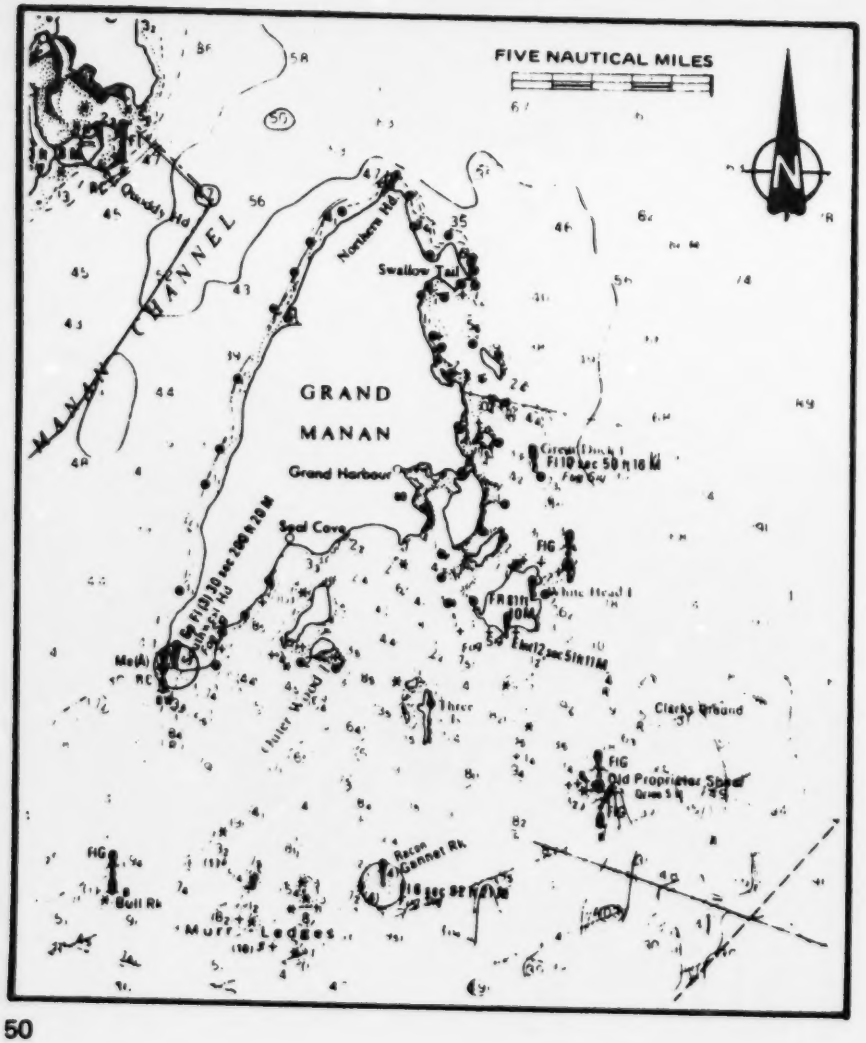
Description - A tiny mussel (½ inch) somewhat resembling a blue mussel.

Habitat - Usually found subtidally among algae.

Distribution and Abundance - (Figure 7.10.14) - D38-P.

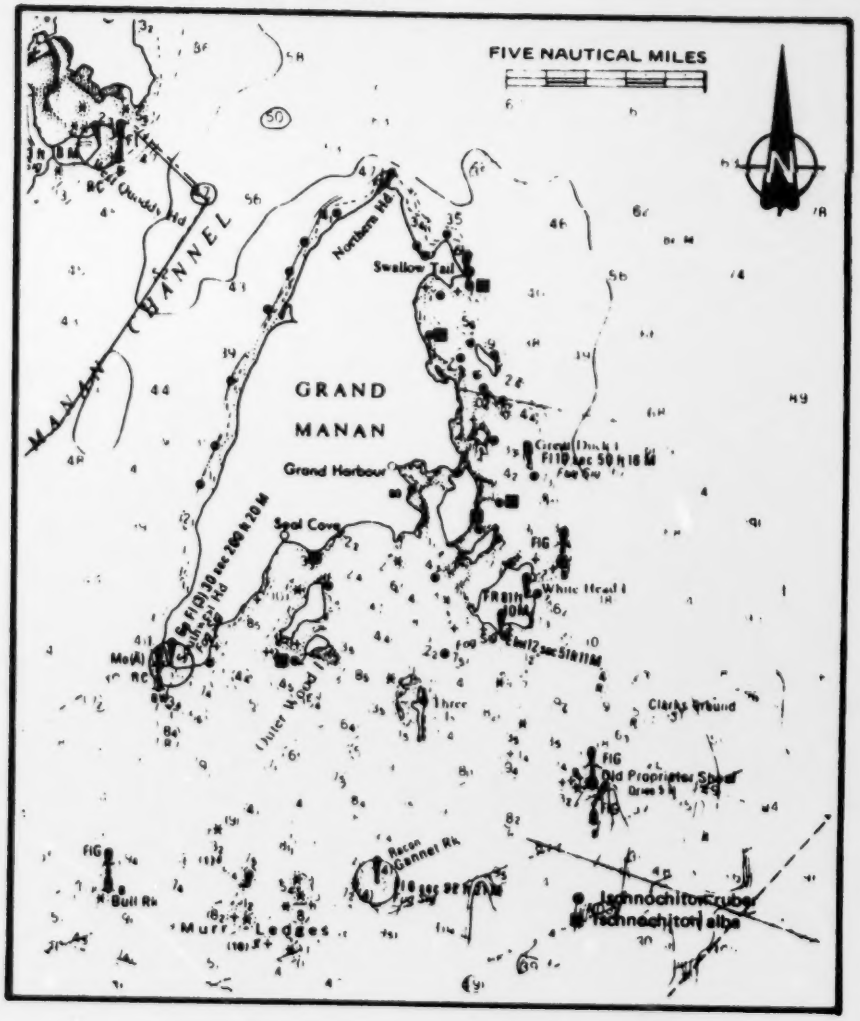
7.10.1
DISTRIBUTION OF THE COMMON LIMPET

THE GRAND MANAN ARCHIPELAGO



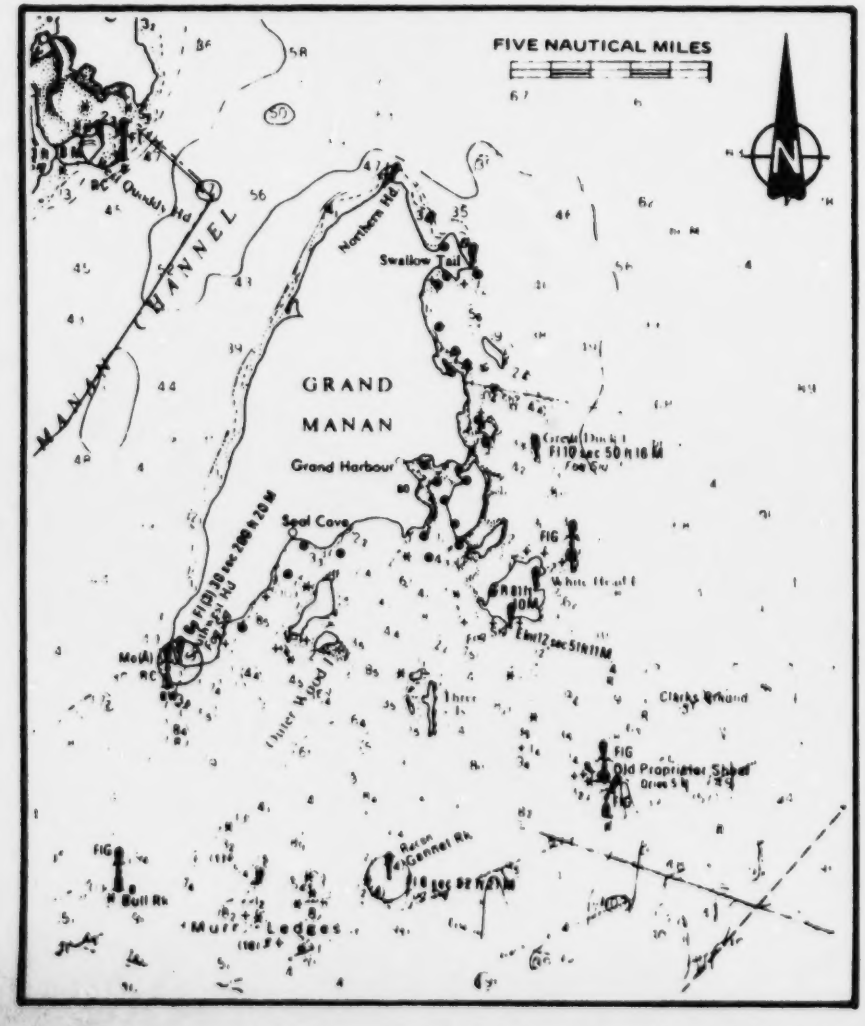
7.10.2
DISTRIBUTION OF THE RED AND THE WHITE CHITON

THE GRAND MANAN ARCHIPELAGO



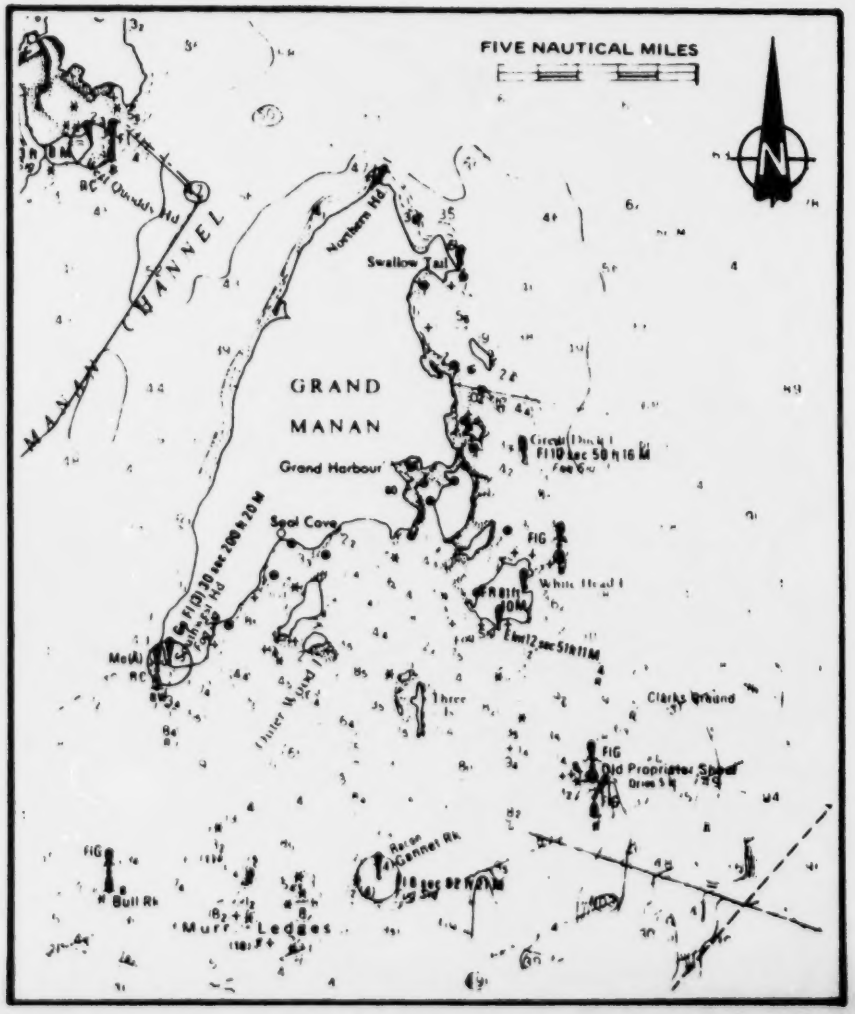
7.10.3
DISTRIBUTION OF THE COMMON PERIWINKLE

THE GRAND MANAN ARCHIPELAGO



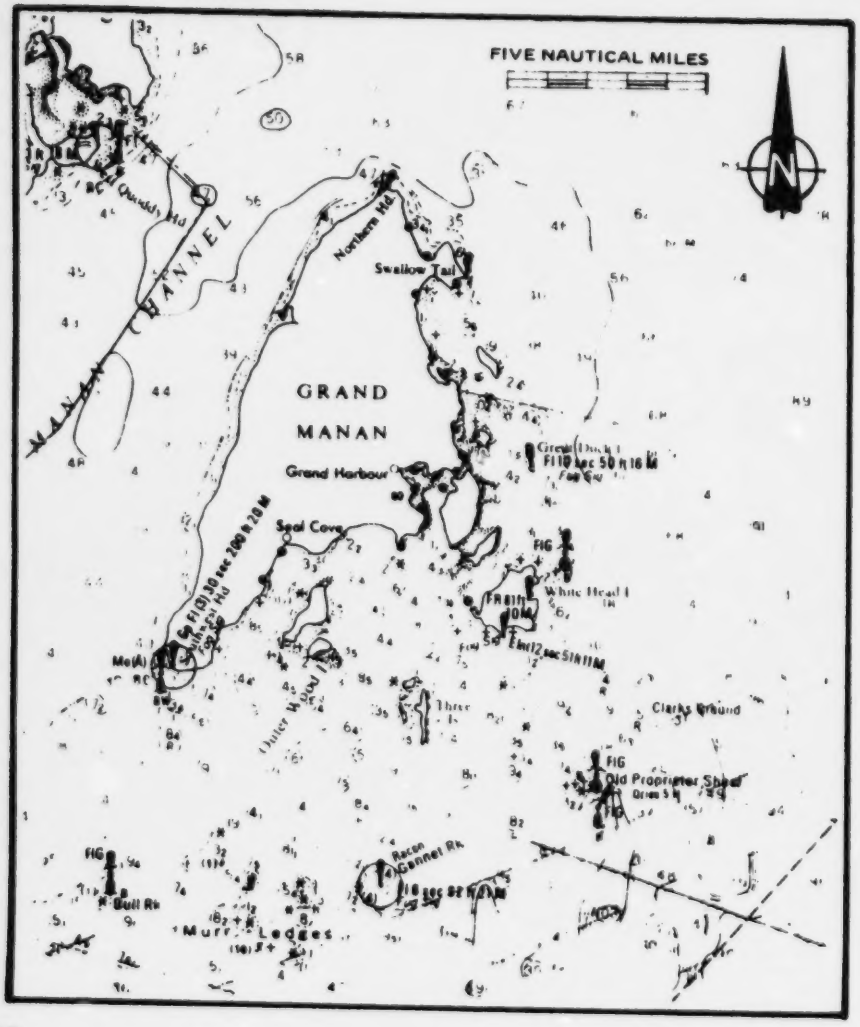
7.10.4
DISTRIBUTION OF THE SMOOTH PERIWINKLE

THE GRAND MANAN ARCHIPELAGO



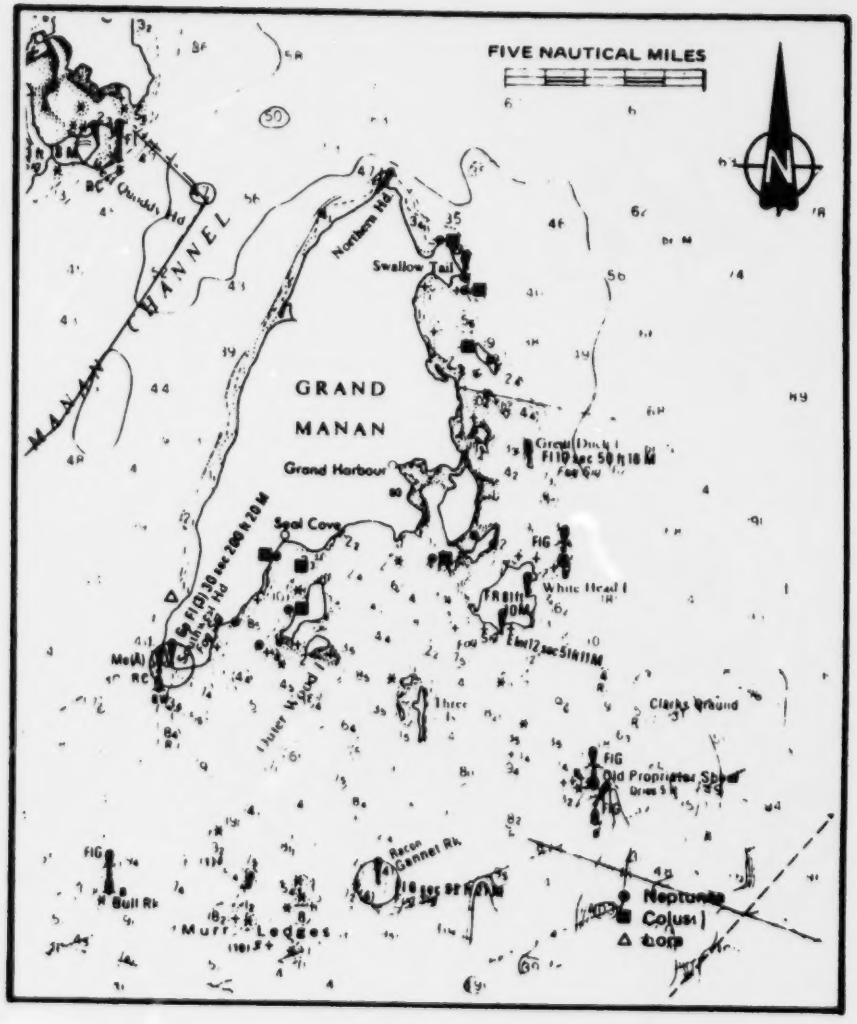
7.10.5
DISTRIBUTION OF THE ROUGH PERIWINKLE

THE GRAND MANAN ARCHIPELAGO



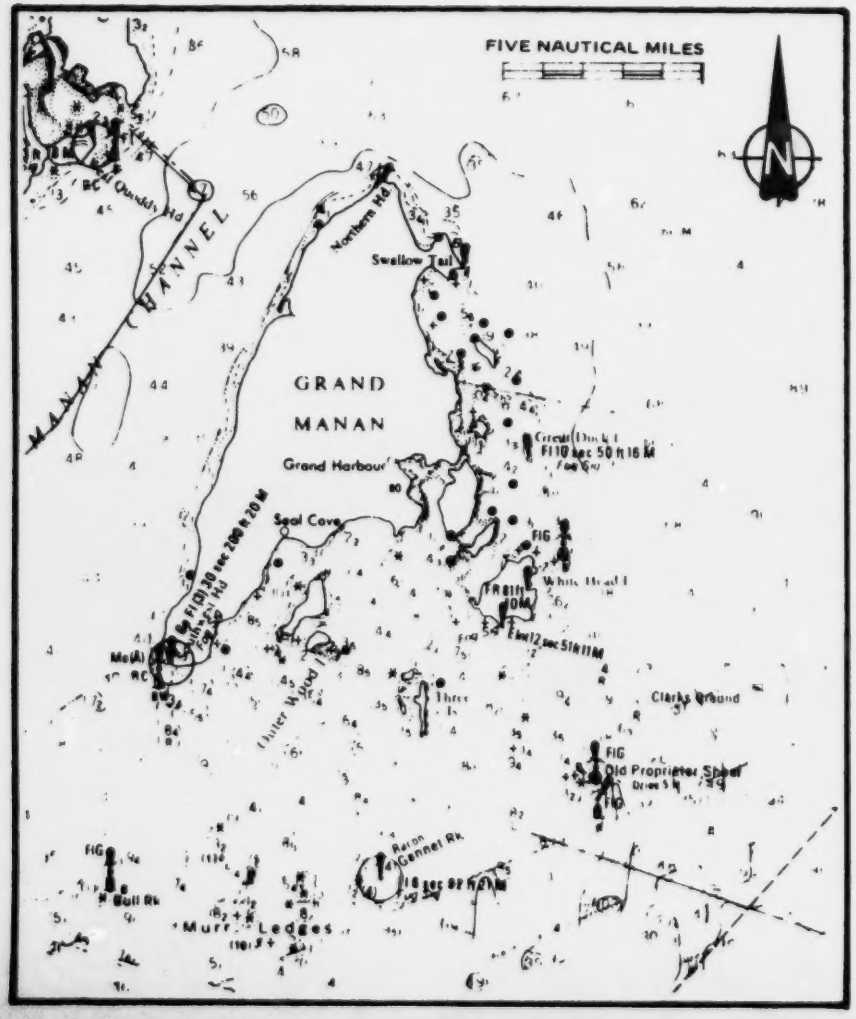
7.10.6
DISTRIBUTION OF TEN-RIDGED WHELK STIMPSON'S WHELK AND LORA

THE GRAND MANAN ARCHIPELAGO



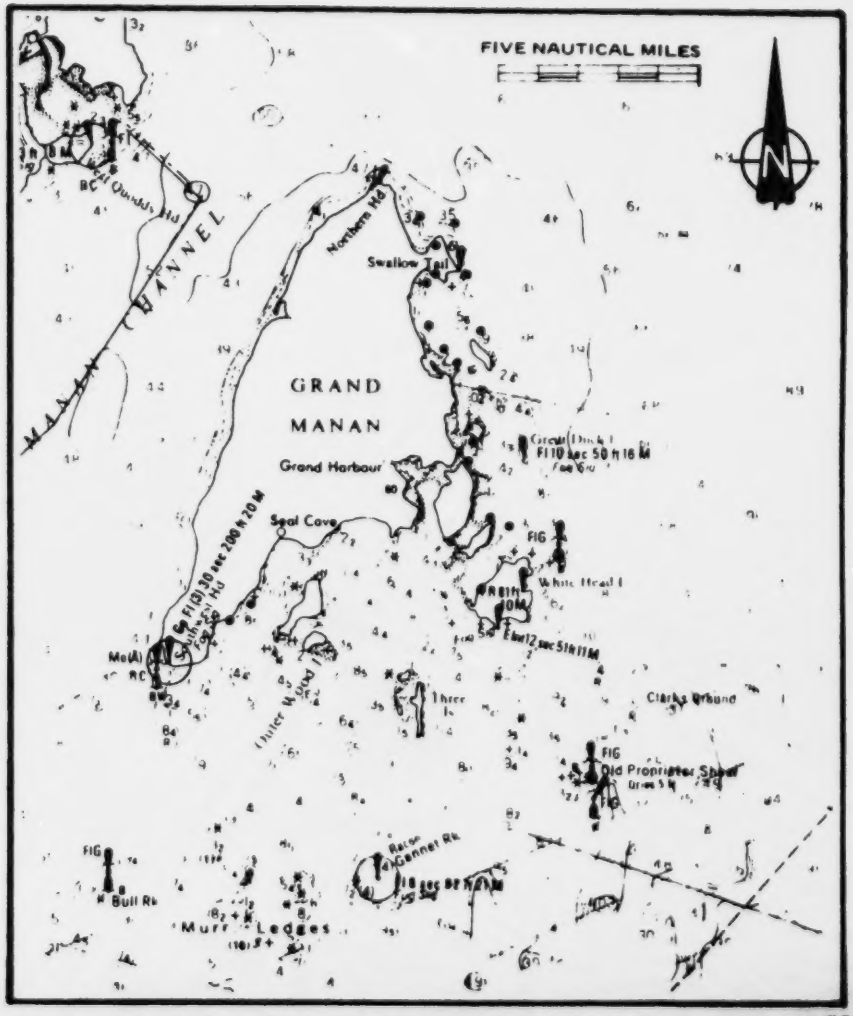
7.10.7
DISTRIBUTION OF THE NORTHERN WHELK

THE GRAND MANAN ARCHIPELAGO



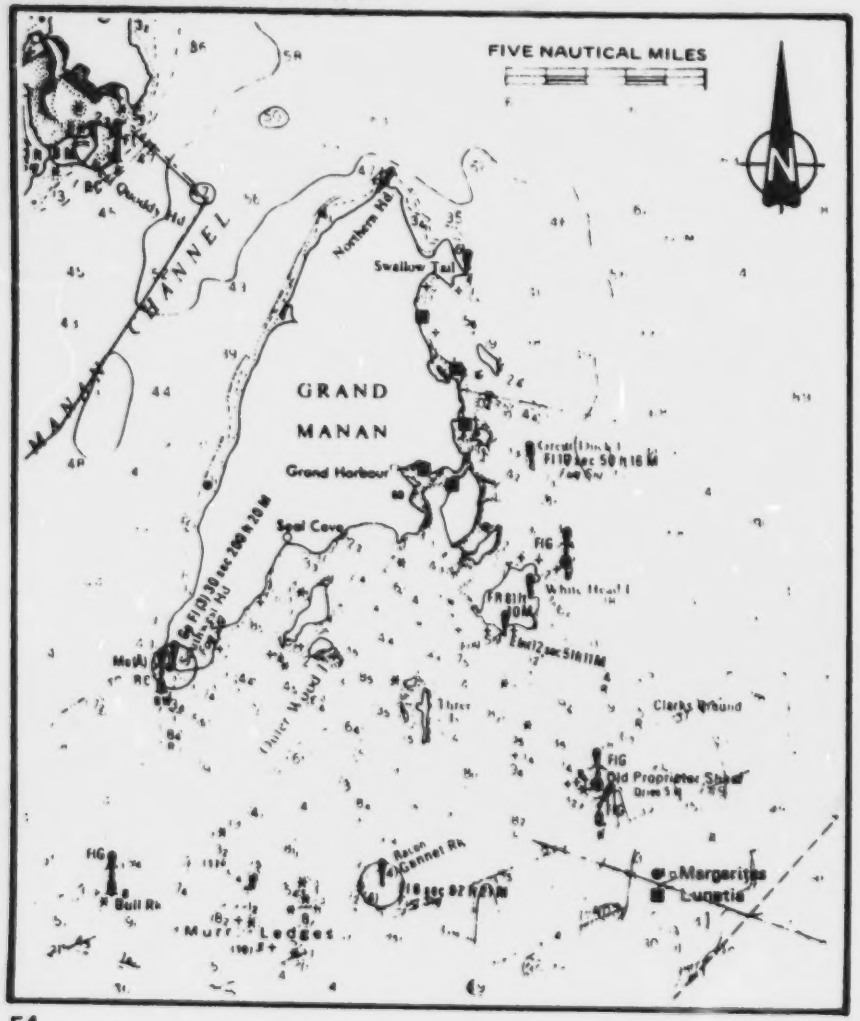
7.10.8
DISTRIBUTION OF THE DOG WHELK

THE GRAND MANAN ARCHIPELAGO



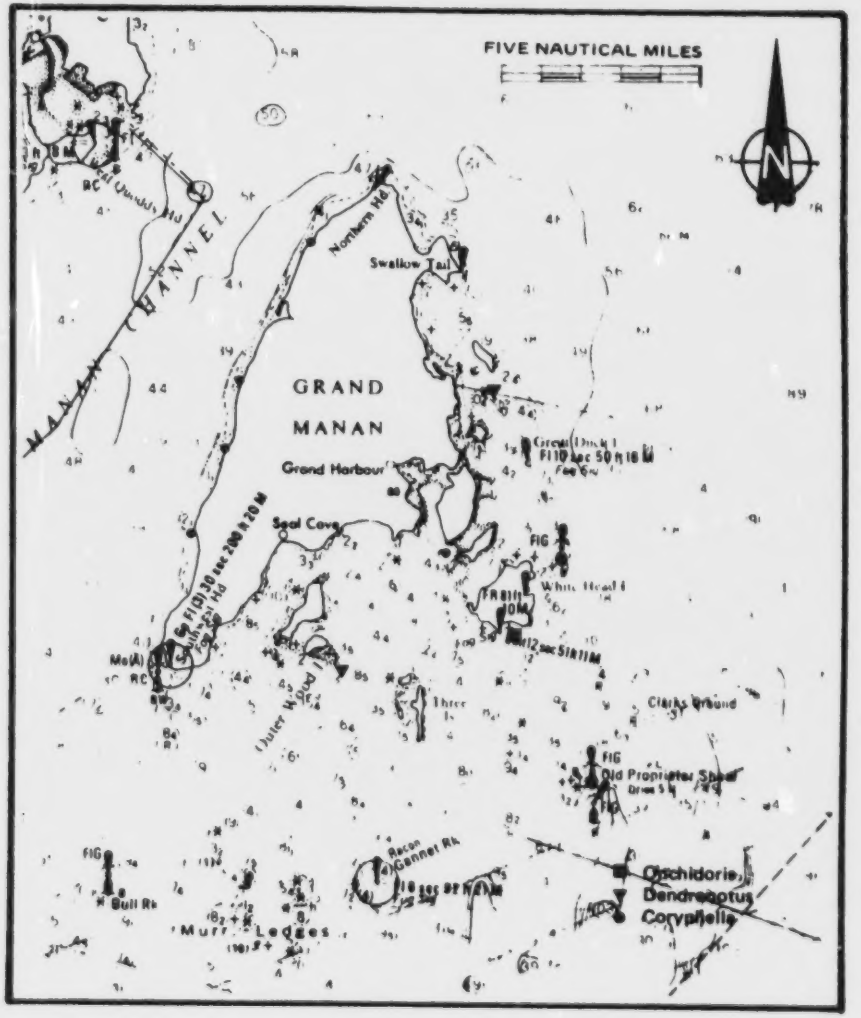
7.10.9
DISTRIBUTION OF THE MOON SNAIL AND TOPSHELL

THE GRAND MANAN ARCHIPELAGO



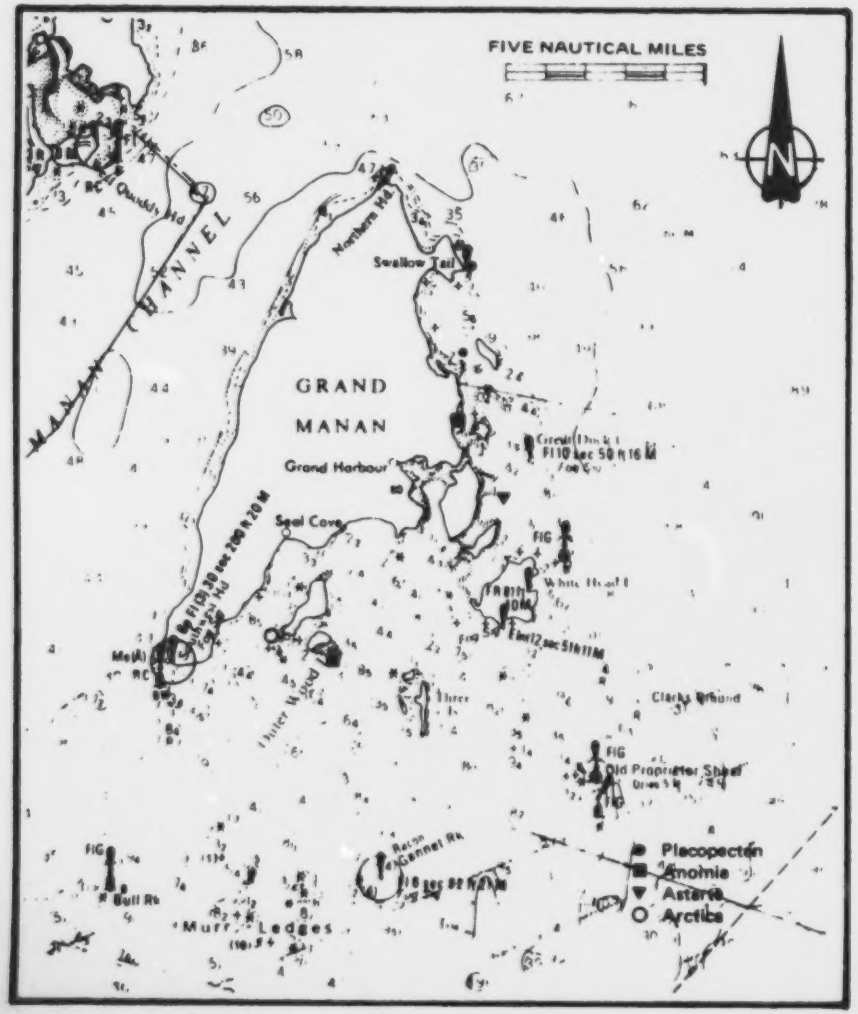
7.10.10
DISTRIBUTION OF NUDIBRANCHS

THE GRAND MANAN ARCHIPELAGO



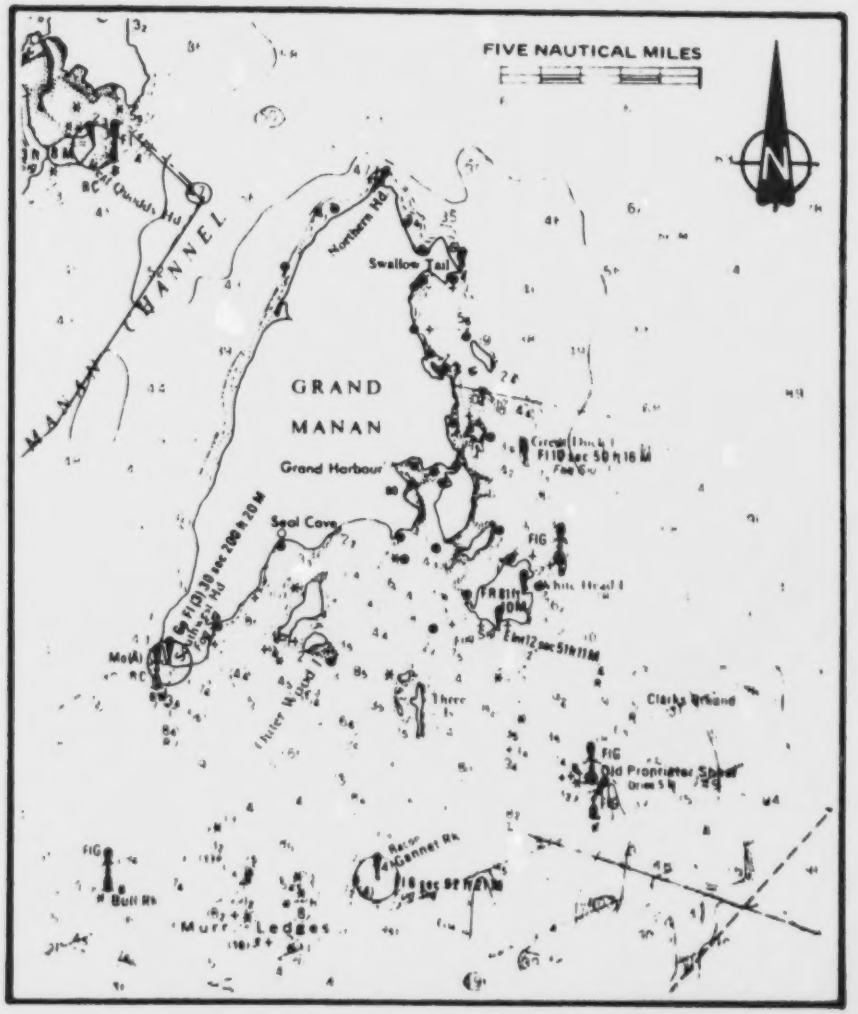
7.10.11
DISTRIBUTION OF VARIOUS BIVALVES

THE GRAND MANAN ARCHIPELAGO



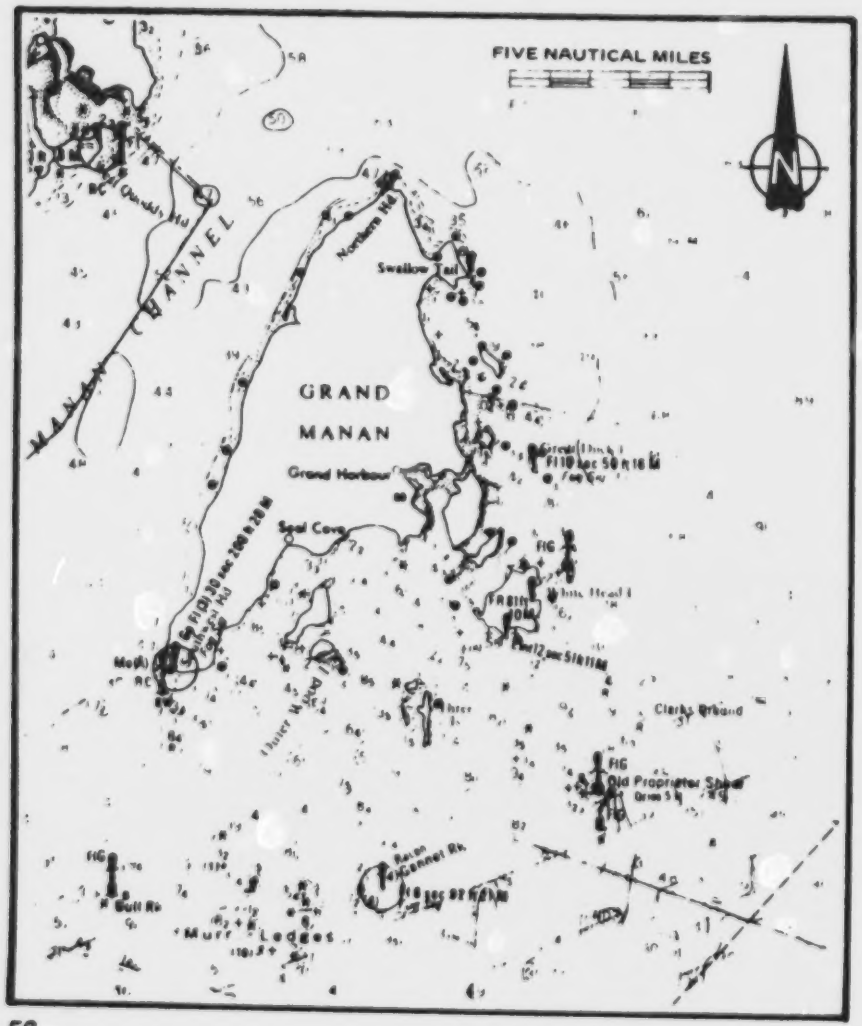
7.10.12
DISTRIBUTION OF THE BLUE MUSSEL

THE GRAND MANAN ARCHIPELAGO



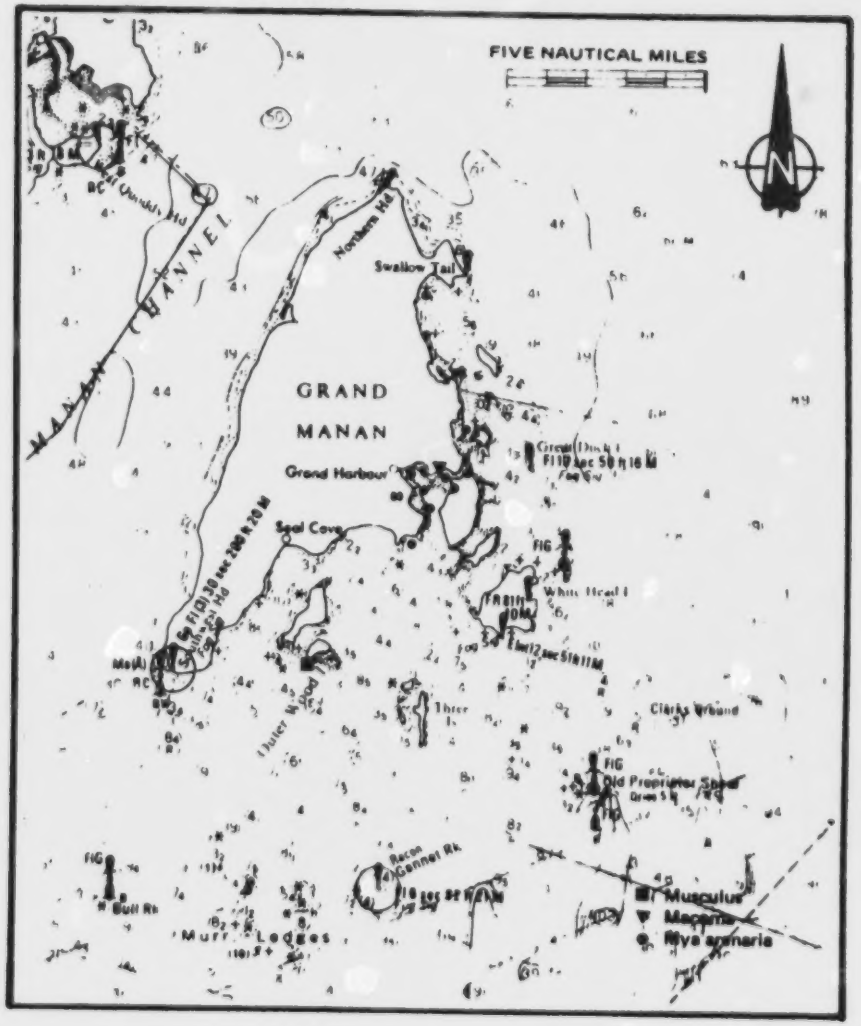
7.10.13
DISTRIBUTION OF THE HORSE MUSSEL

THE GRAND MANAN ARCHIPELAGO



7.10.14
DISTRIBUTION OF THE SOFT-SHELLED CLAM MUSCULUS AND MACOMA

THE GRAND MANAN ARCHIPELAGO



ANNELIDA
(SEGMENTED WORMS)

7.11 INTRODUCTION

Numerous species of worms occur abundantly in every habitat in the Bay of Fundy. They are particularly common in mud. Consequently, many species in subtidal mud are not likely to be recorded unless mud samples are taken, sieved and sorted. Since this was beyond the scope of this survey, it can be expected that other species occur in the study area.

7.12 ANNOTATED LIST OF SPECIES

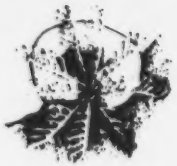
7.12.1 TUBE WORM/*Potamilla reniformis* (Leuckart)

Description - Up to 10 cm long, this worm secretes a tough leathery tube from which its banded tentacles emerge.

Habitat - Occurs subtidally in cracks in ledge and rock.

Distribution and Abundance - (Figure 7.12.1) - T1-P-C, T2-C, T5-P, D6-P, D29-P, D42-P, D43-C, D44-P, D47-P.

7.12.2 COILED TUBE WORM/*Spirorbis borealis* Daudin



Description - This tiny (2-3 mm) worm lives in a small pasty-white coiled tube.

Habitat - Occurs intertidally and subtidally on rocks and algae. Often extremely abundant.

Distribution and Abundance - (Figure 7.12.2) - T5-C, D4-C, D12-C, D13-A, D15-P, D16-P, D17-A, D20-A, D21-C, D29-P, D31-C, D38-A, S1-C, S6-P, S17-P-C, S18-P-C, S19-C.

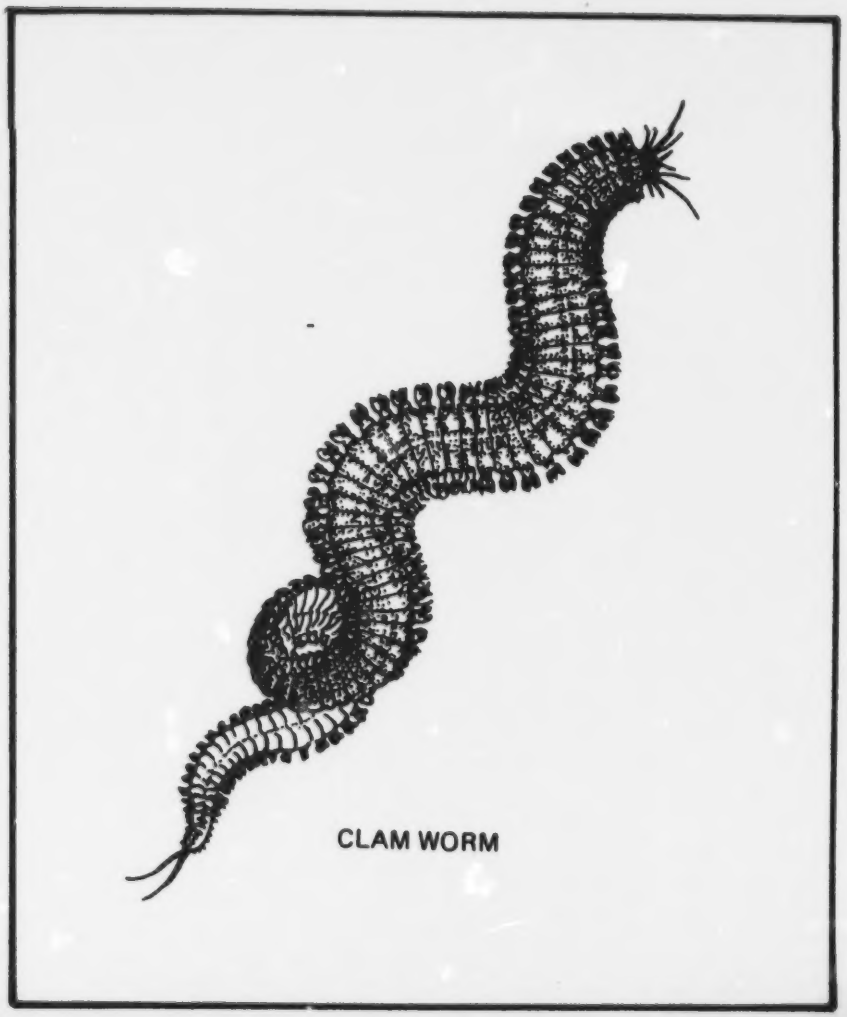
7.12.3 SCALEWORM/*Lepidonotus squamatus* (Linnaeus)

Description - Up to 5 cm long, scale worms are characterized by two rows of dorsal scales.

Habitat - Occurs intertidally and subtidally under stones and debris.

Distribution and Abundance - T4-P, D13-C, S1-C.

Harmothoe sp. - S20-P.



CLAM WORM

7.12.4 TUBE WORM/*Amphitrite johnstoni* Malmgren

Description - Up to 20 cm long this tube worm lives in tubes constructed from mud.

Habitat - Intertidally in mud, among blue mussels and under rocks, particularly in tide pools. Subtidally occurs in cracks in ledges and rocks and under stones.

Distribution and Abundance - (Figure 7.12.1) - D29-P, D47-A, S1-P, S19-P.

7.12.5 FEATHERED FAN WORM/*Myxicola infundibulum* (Montagu)

Description - This species reaches 8 cm, contracted length. It is characterized by its gelatinous tube and funnel-shaped brachial crown.

Habitat - Occurs subtidally from low water to 100 feet and more. Most commonly found in cracks in bedrock, under rocks, among Horse Mussels and in loose rock debris.

Commercial Utilization - *M. infundibulum* is an important commercial species used in neurophysiological research. Natural stocks permit some harvesting in the study area.

Distribution and Abundance - (Figure 7.12.4) - T4-P, T5-P, T6-P, T7-P, D1-P, D3-P, D4-P-C, D5-P, D6-P, D11-P, D12-P-C, D14-A, D15-P, D16-C, D17-A, D19-C, D20-P, D21-P, D27-C, D29-P, D37-P, D39-P, D47-P.

7.12.6 LUG WORM/*Arenicola marina* (Linnaeus)

Description - Up to 20 cm long; cylindrical body; grey to grey green

Habitat - Burrows in sandy substrate intertidally and subtidally.

Distribution and Abundance - (Figure 7.12.3) - D33-C, D34-C, S8-P, S9-P-C, S12-P-C, S15-P-C.

7.12.7 BAMBOO WORM/*Clymenella torquata* (Malmgren)

Description - A long , cylindrical worm reaching 10 - 12 cm; reddish; segments widely spaced resembling a piece of bamboo.

Habitat - Occurs intertidally and subtidally in sand

Distribution and Abundance - (Figure 7.12.3) - S6-C-A, S12-A, S16-C, S19-C.

7.12.8 SHIMMY WORM/*Nepthys incisa* Malmgren

Description - Up to 15 cm; an active segmented worm; characteristically everts its proboscis when disturbed.

Habitat - Occurs abundantly in intertidal and subtidal mud.

Distribution and Abundance - (Figure 7.12.5) - S15-C, S16-P.

7.12.9 CLAM WORM/*Nereis virens* Sars

Description - A large segmented worm reaching 40 cm and more; highly segment brownish; red and green.

Habitat - Intertidally and subtidally in mud.

Distribution and Abundance - (Figure 7.12.5) - S33-P, S7-C, S19-P.

Nereis pelagica - D39-A.

7.12.10 TUBE WORM/*Filograna implexa* Berkeley

Description - Tiny worms form intertwining masses of tiny, slender white tubes. Masses may reach 6 inches or so in diameter.

Habitat - Occur subtidally, usually on rocky bottom.

Distribution and Abundance - (Figure 7.12.1) - D12-P.

7.12.11 GOULD'S TRUMPET WORM/*Pectenaria granulata* (Linnaeus)

Description - Up to 5 cm long, this worm lives in a trumpet-shaped tube made from sand grains.

Habitat - Occurs intertidally in tide pools under rocks and among blue mussels.

Distribution and Abundance - (Figure 7.12.3) - T5-C, S21-P.

FLATWORMS/PLATYHELMINTHES

7.12.12 FLATWORM/*Notoplana atomata* (Muller)

Description - A large (20 mm) elongated oval flatworm; brownish.

Habitat - Intertidally under stones and in tide pools.

Distribution and Abundance - (Figure 7.12.6) - T6-P.

RIBBON WORMS/NEMERTEA

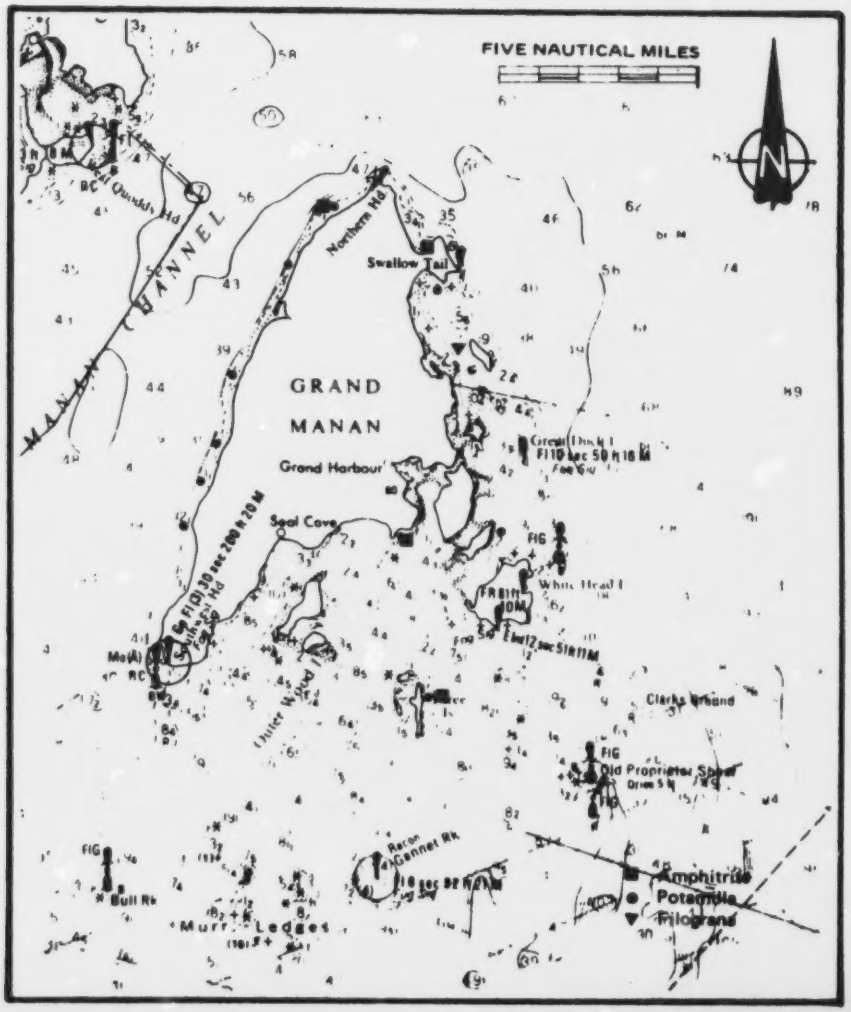
7.12.13 RIBBON WORM/*Lineus sp.*

Description - A long (150 mm) slender worm; color varies from red to black and brown.

Habitat - Occurs abundantly in masses under stones. Usually associated with mud.

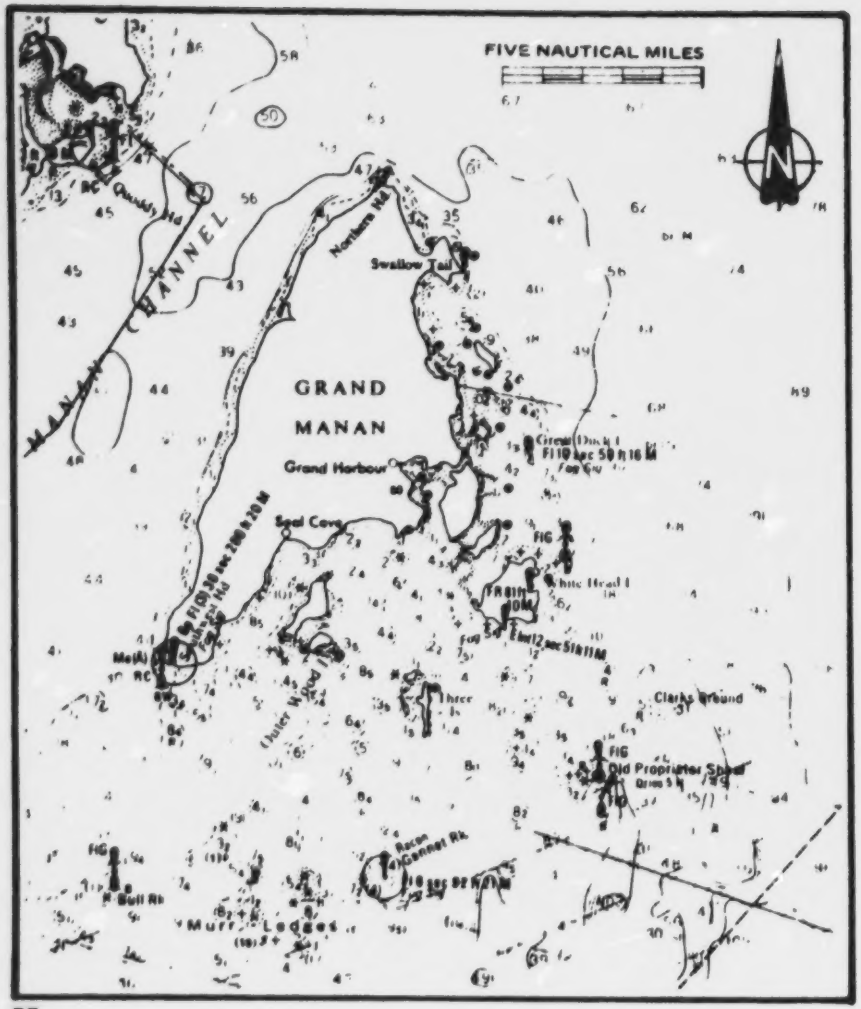
Distribution and Abundance - (Figure 7.12.7) - S2-P, S4-P, S6-P, S8-P, S9-P, S11-P-C, S12-P, S15-P, S16-P, S17-P-C, S18-P, S19-P, S22-P ,S26P

7.12.1
DISTRIBUTION OF VARIOUS ANNELIDS THE GRAND MANAN ARCHIPELAGO



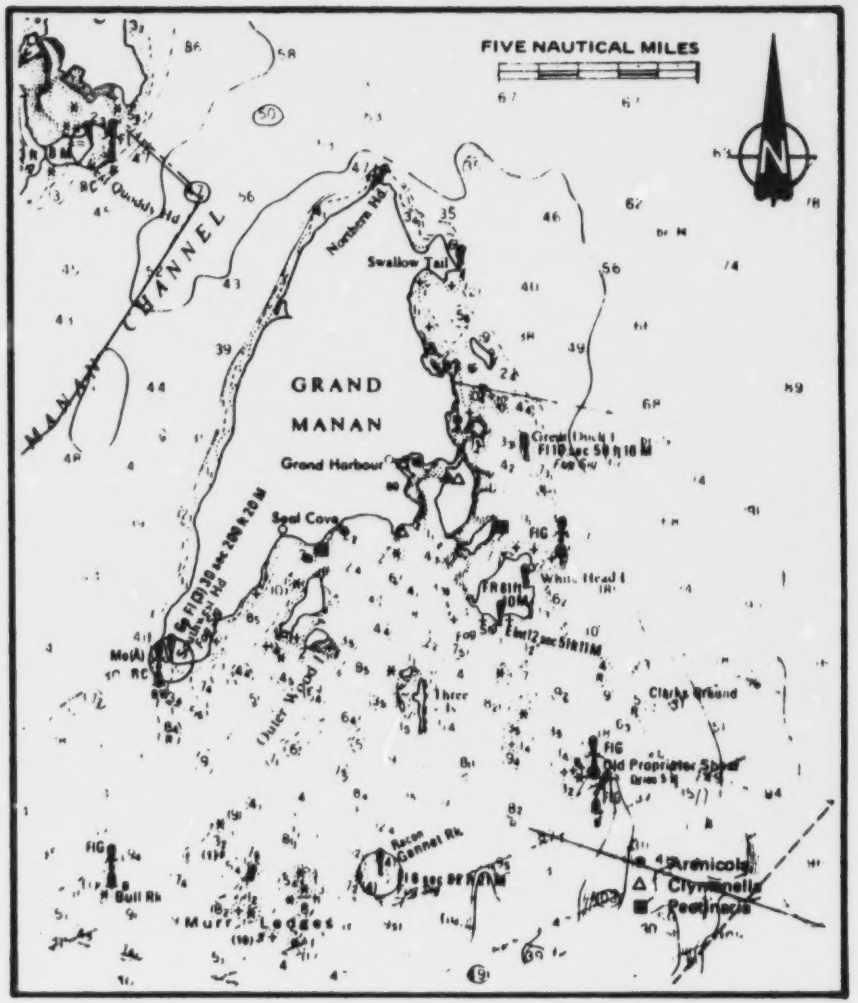
7.12.2
DISTRIBUTION OF THE COILED TUBEWORM

THE GRAND MANAN ARCHIPELAGO



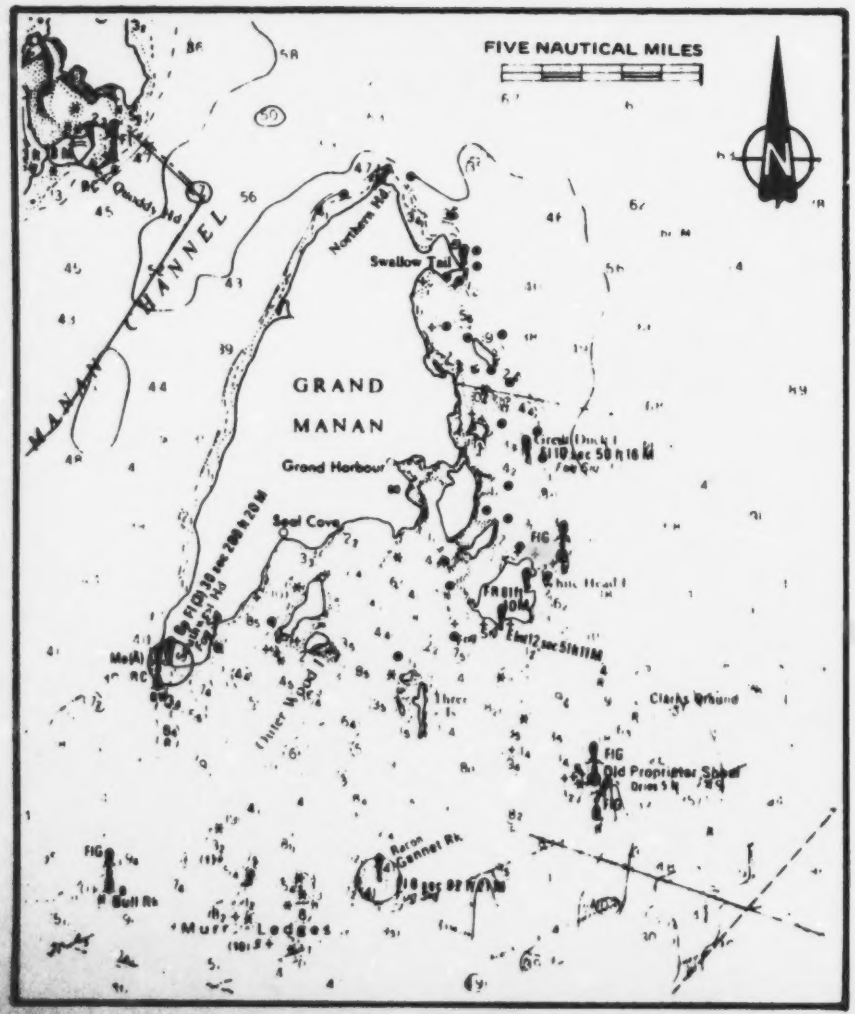
7.12.3
DISTRIBUTION OF VARIOUS ANNELIDS

THE GRAND MANAN ARCHIPELAGO



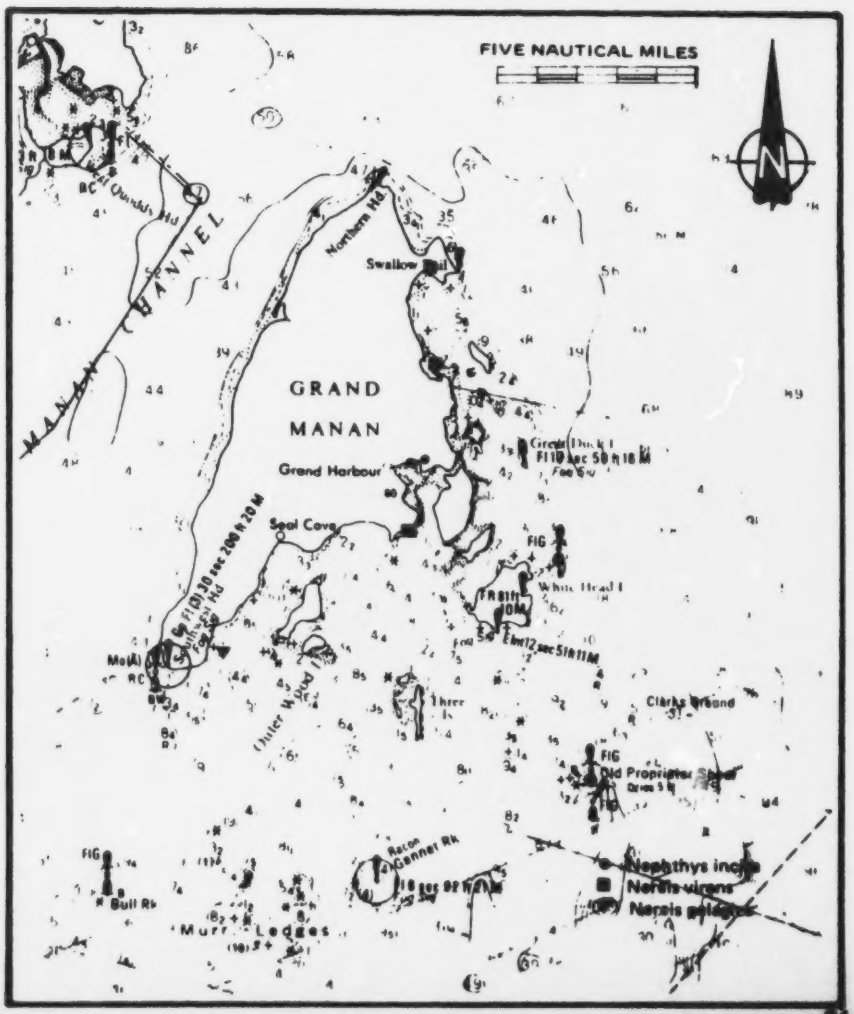
7.12.4
DISTRIBUTION OF THE FEATHERED FANWORM

THE GRAND MANAN ARCHIPELAGO



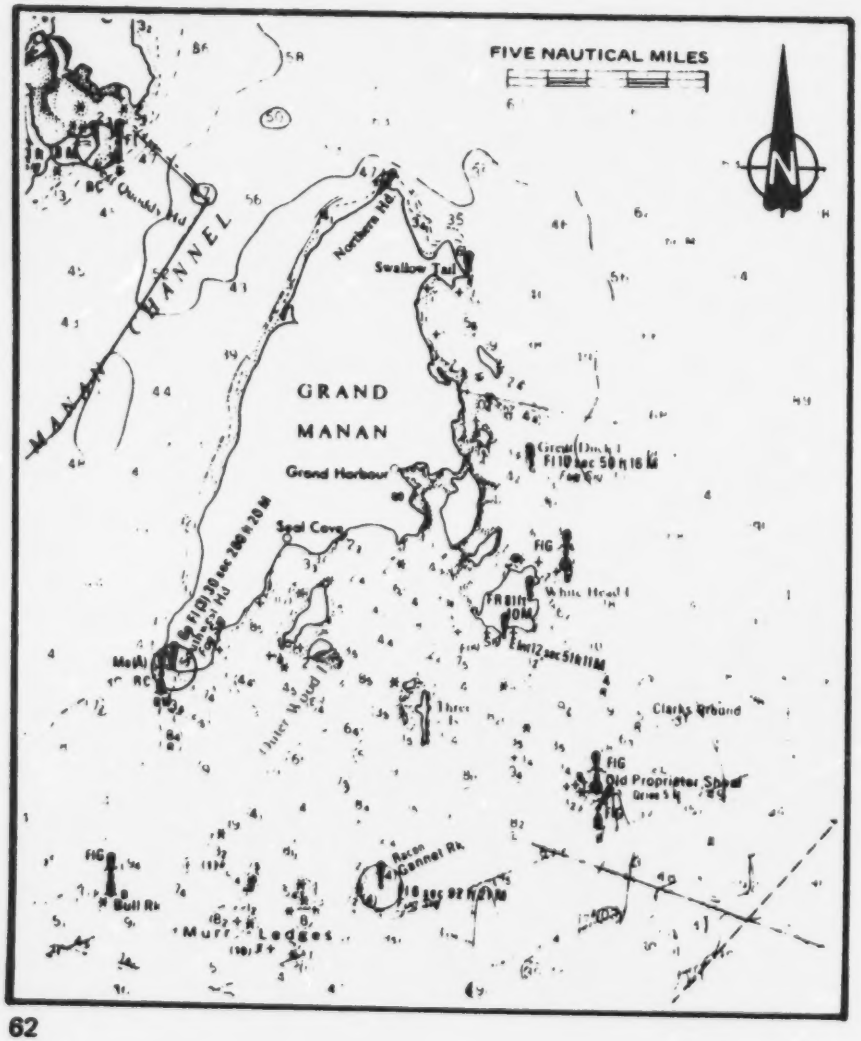
7.12.5
DISTRIBUTION OF VARIOUS ANNELIDS

THE GRAND MANAN ARCHIPELAGO



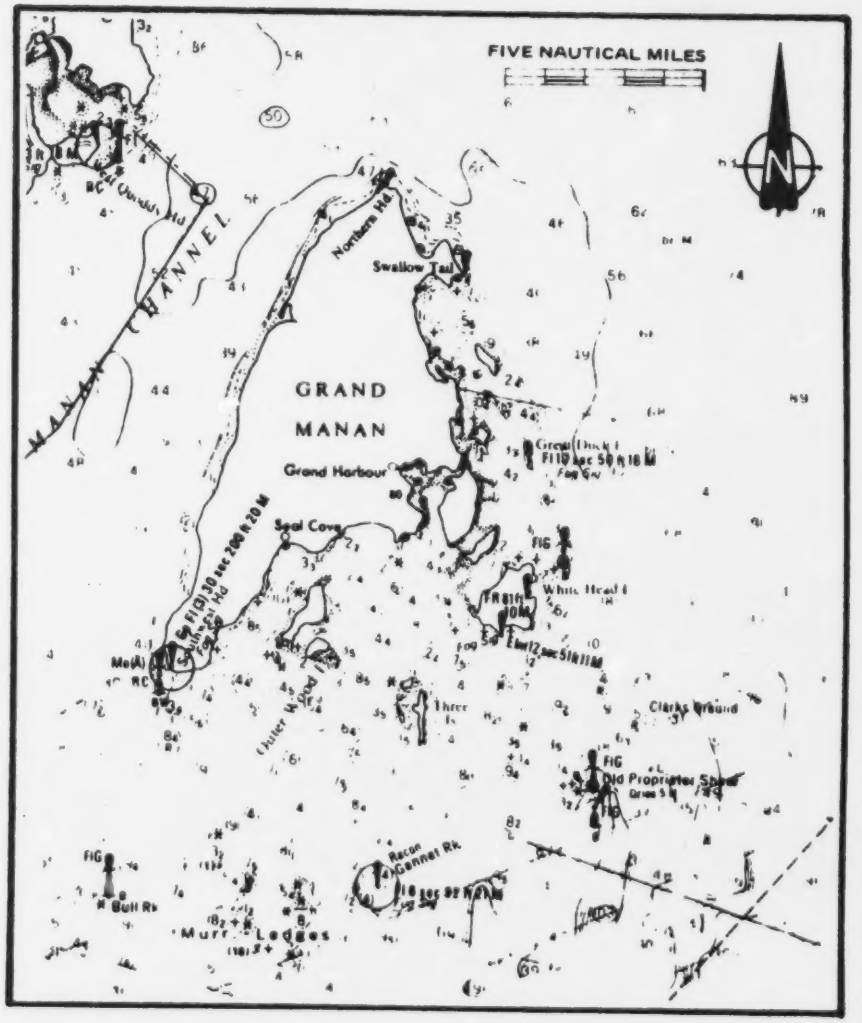
7.12.6
DISTRIBUTION OF THE FLATWORM NOTOPLANA

THE GRAND MANAN ARCHIPELAGO



7.12.7
DISTRIBUTION OF THE RIBBONWORM LINEUS

THE GRAND MANAN ARCHIPELAGO



ARTHROPODA
(CRABS, LOBSTER, SHRIMP, ETC.)

7.13 INTRODUCTION

Shrimps, crabs, barnacles, amphipods, lobster and other arthropods form one of the dominant groups in the Bay of Fundy. They are found on all substrates intertidally to high water and subtidally to great depths. All major species are well represented in the study area.

Lobster and shrimp are important commercial species and the Rock Crab, which has potential for commercial utilization, is common in the study area.

7.14 ANNOTATED LIST OF SPECIES

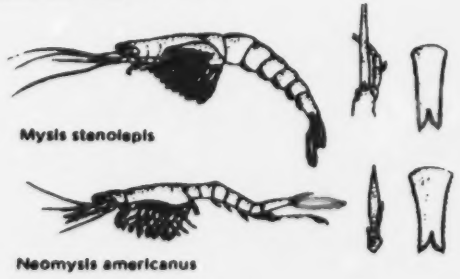
7.14.1 SHRIMP/*Spirontocaris sp.*

Description - Large teeth on back of carapace; to 2¼ inches; color-varies; most commonly shades of brown and white.

Habitat - Occurs subtidally, from low water to depths in excess of 100 feet. Commonly found living in kelp beds.

Distribution and Abundance - (Figure 7.14.1) - T1-P, T5-P, T6-P, D13-P-C, D35-P, D40-P, D42-P-C, D46-P, D47-P.

7.14.2 FAIRY SHRIMP/*Mysis sp.*

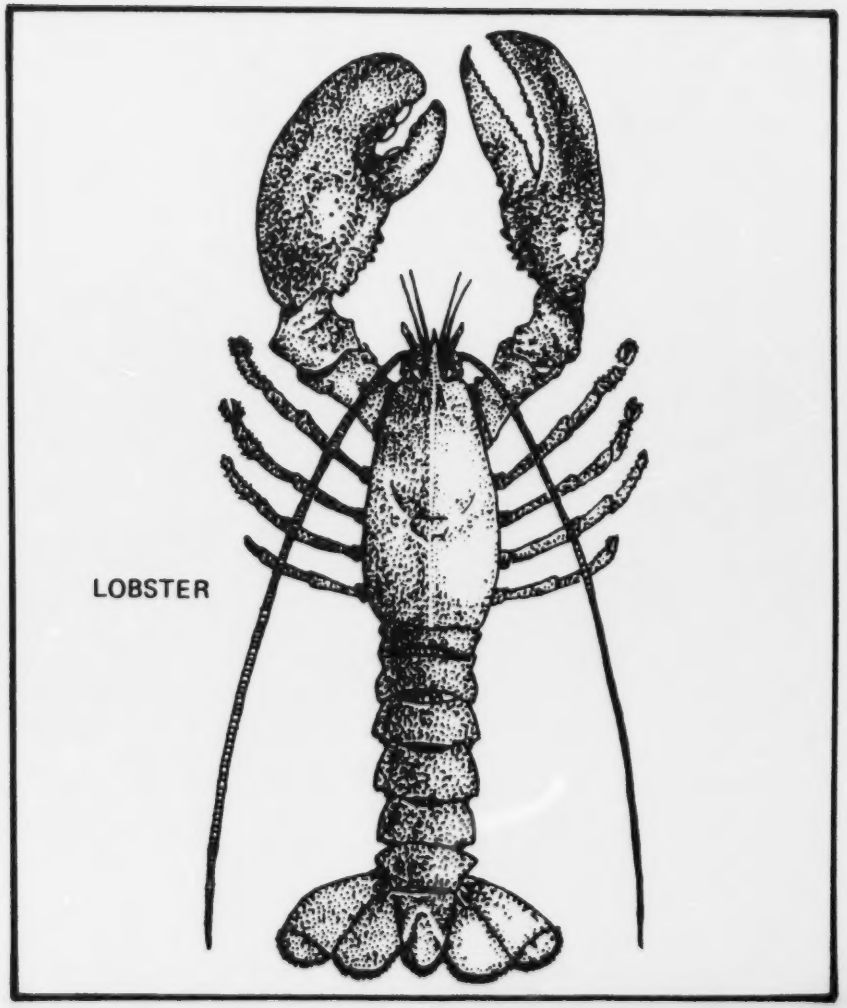


Description - To 1¼ inches; transparent with prominent black eyes.

Habitat - Occurs intertidally in ponds and tide pools. Commonly found just below low tide in summer. It appears to drop to lower depths during winter months. Normally swims just above the bottom; most commonly on mud or sand substrates.

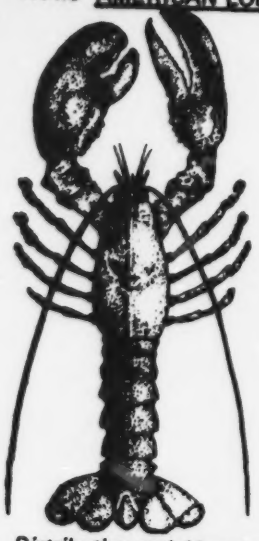
Distribution and Abundance - (Figure 7.14.2) -
Neomysis americanus - T3-C, T4-C, T6-P, D8-A, D12-A, D20-C.

Mysis stenolepis - D3-P, D11-A, D35-P, D37-C, S25-C.



LOBSTER

7.14.3 AMERICAN LOBSTER/*Homarus americanus* (Milne Edwards)



Description - Average size for market-10 inches and 1 to 2 pounds but recorded to 34 inches; dark green above, yellow, orange, red, below.

Habitat - Occurs subtidally from low water to depths in excess of 100 feet on a variety of substrates. Usually observed in burrows under rocks or holes in ledges during late summer and fall.

Commercial Utilization -A good commercial fishery exists for this species in the study area. See section 9 for additional details.

Distribution and Abundance - (Figure 7.14.3) - D3-P, D4-P-C, D7-P, D27-A, D29-P, D31-P.

7.14.4 COMMON BARNACLE/*Balanus balanoides* (Linnaeus)

Description - less than ½ inch; white.

Habitat - Occurs intertidally on rocks, wharves and pilings. Most common near the middle of tidal zone to high water.

Distribution and Abundance - (Figure 7.14.4) - T2-A, T5-P-A, T9-P, S2-P-C, S3-P-C, S4-P-C, S5-P, S6-P-C, S8-P, S9-P-C, S11-P-C, S12-P, S13-P-C, S14-P, S15-P-C, S16-P, S17-P, S19-P-C, S21-C, S22-P-C, S23-P, S24-C, S25-C, S26-P-C.

7.14.5 BARNACLE/*Balanus balanus*

Description - A large barnacle reaching 5 cm.

Habitat - Usually found subtidally under rocks and on Horse mussel and scallop shells.

Distribution and Abundance - (Figure 7.14.5) - D4-C, D12-P, D16-P, D17-P, D19-P, D31-P-C, D39-P, D47-P.

7.14.6 GOOSE BARNACLE/*Lepas sp.*

Description - Shell thin, paper-like, stalk fleshy; to 2 inches; white, bluish white.

Habitat - Occurs on seaweed, wood or other floating objects. Often found in large patches of drift weed, solitary or in large groups. Appears to be seasonal in the study area; occurring only in the summer months.

Distribution and Abundance - (Figure 7.14.5) - D44-P.

7.14.7 CAPRELLIDS/*Caprella sp.*

Description - Slender body; to 1 inch; translucent, reddish, red, or mottled.

Habitat - Occurs subtidally on hydroids, sponges, tunicates, etc. It is particularly abundant on weir twine at times.

Distribution and Abundance - (Figure 7.14.6).

7.14.8 AMPHIPOD/*Corophium volutator* (Pallas)

Description - Slender body; to ½ inch; translucent brown with some banding.

Habitat - Occurs intertidally in tubes in soft mud.

Distribution and Abundance - S16-P.

7.14.9 BEACH FLEA/*Gammarus oceanicus* Segerstrale

Description - Common beach flea; to 1 inch; Green, brown, various shades.

Habitat - Occurs intertidally on most shores. Common under rocks and seaweed.

Distribution and Abundance - (Figure 7.14.6) - S1-P, S2-P, S3-C, S4-P-C, S5-P, S6-P, S8-P-C, S9-C, S10-P, S11-P-C, S12-P-C, S13-P, S14-P-C, S15-C, S17-P, S18-C, S19-C, S22-P-C, S23-P, S24-C, S25-C, S26-P.

7.14.10 BEACH HOPPER/*Orchestia agilis*

Description - Common beach hopper; to 1/8 inch; dark brown, green.

Habitat - Occurs most abundantly under drift weed at high water mark.

Distribution and Abundance - Not recorded but undoubtedly present.

7.14.11 AMPHIPOD/*Tryphosa pinguis*

Description - to 1 cm; pink, white.

Habitat - Occurs subtidally, usually on mud bottoms, from low water to depths in excess of 100 feet; often found feeding on dead fish.

Distribution and Abundance - (Figure 7.14.6) - D39-C-A.

7.14.12 ISOPOD/*Idotea sp.*

Description - Elongated oval shape, similar to terrestial sowbug; to ¾ inch; various shades of brown and black with banding. Color changes to match habitat.

Habitat - Occurs intertidally in tidepools under rocks, often associated with eel grass and on algae such as *Ascophyllum.*

Distribution and Abundance - S18-C.

7.14.13 ISOPOD/*Limnoria sp.?*

Description - Elongated oval shape; to 1/8 inch; black, brown.

Habitat - Occurs intertidally under rocks, etc. Most abundant in small drainage areas.

Distribution and Abundance - S26-P.

7.14.14 SAND SHRIMP/*Crangon septemspinosus* Say

Description - Common sand shrimp; to 2½ inches; brown or grey with dark spots.

Habitat - Occurs intertidally and subtidally on sand and mud bottoms; present in tidepools.

Distribution and Abundance - (Figure 7.14.1) - D11-P, S12-P.

7.14.15 ROCK CRAB/*Cancer borealis* (Stimpson)

Description - Heavy carapace; to 6 inches; brick red dorsally, white, yellow ventrally.

Habitat - Occurs subtidally on varied substrates from low water to depths in excess of 100 feet. Occasionally found intertidally buried in sand or under rocks.

Commercial Utilization - Good potential exists for a fishery with some markets developing at the present time. See section 9 for further details.

Distribution and Abundance - (Figure 7.14.7) - T3-P, T4-P, T6-P, T8-P, T9-P, D5-P-C, D7-P, D8-P, D13-P, D15-P, D24-C, D25-C, D27-C, D28-C, D31-C, D32-P, D35-P, D36-P, D38-P, D39-P, D42-P, S1-P.

7.14.16 GREEN CRAB/*Carcinus maenas* (Linnaeus)

Description - Light carapace; to 4 inches; dark green dorsally, light green, yellow ventrally.

Habitat - Occurs intertidally under seaweed and rocks from mid littoral to low water. Occurs subtidally around wharves and muddy basins.

Distribution and Abundance - (Figure 7.14.8) - S2-P, S4-P, S6-P, S8-P, S11-P, S12-P, S13-P, S19-C, S22-P, S23-P.

7.14.17 | TOAD CRAB/*Hyas sp.*

Description - To 3 inches in body length; brick red to dirty brown; often decorated with sponges etc.

Habitat - Occurs subtidally from low water to depths in excess of 100 feet on various substrates.

Distribution and Abundance - (Figure 7.14.8) - T2-P, D47-P.

7.14.18 HERMIT CRAB/*Pagurus sp.*

Description - Lives in various empty Gastropod shells; soft-bodied except for legs and claws; usually red with white, some with blue. One common species is covered with brown hairs.

Habitat - Occurs subtidally from low water to depths in excess of 100 feet; on all substrates. Rarely found intertidally in tide pools.

Distribution and Abundance - (Figure 7.14.9) - T3-P-C, T4-P, T5-P, T9-P, D1-A, D3-P, D4-P, D5-P, D6-P, D7-P-C, D8-P, D9-P, D11-P, D12-P, D14-P, D18-P, D21-P, D24-C, D27-A, D28-C, D29-P-C, D31-P, D32-C, D33-C, D35-P-C, D36-P, D37-P, D41-P, S1-C.

7.14.19 PANDALUS SHRIMP/*Pandalus montagui*

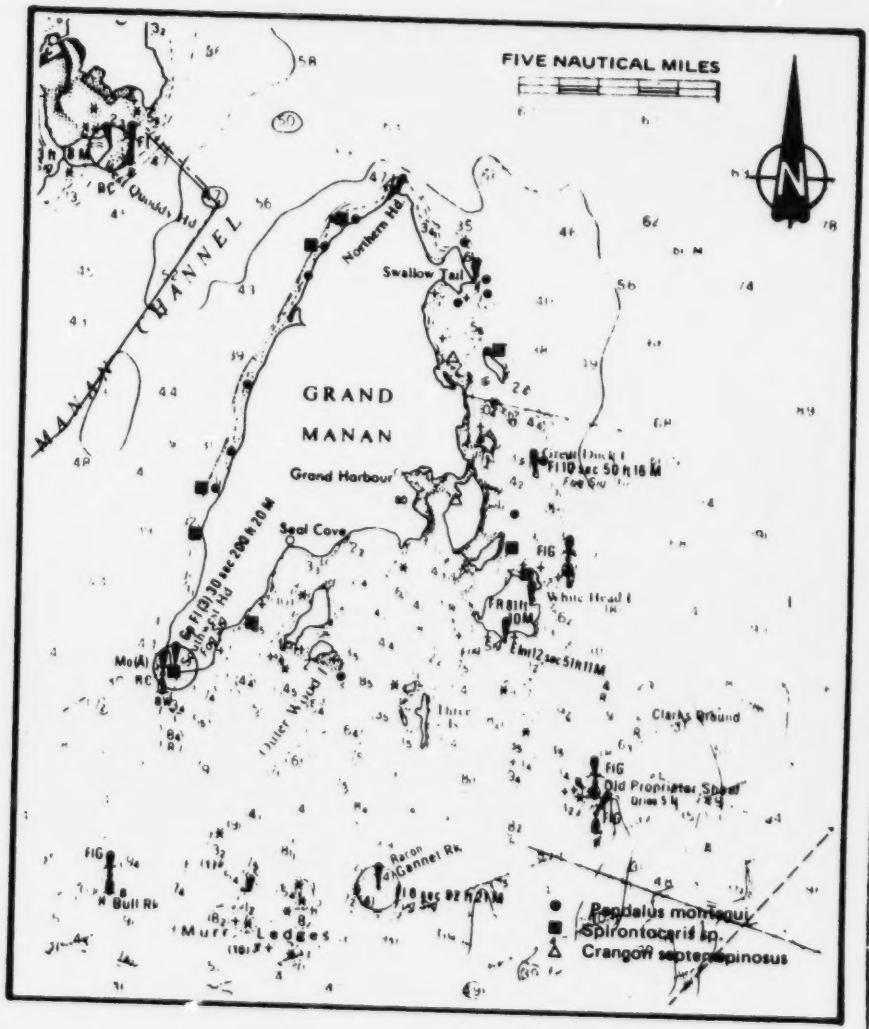
Description - A typical shrimp reaching 3 inches or so in length.

Habitat - Common in cracks and crevices of subtidal ledges and under overhangs and rocks.

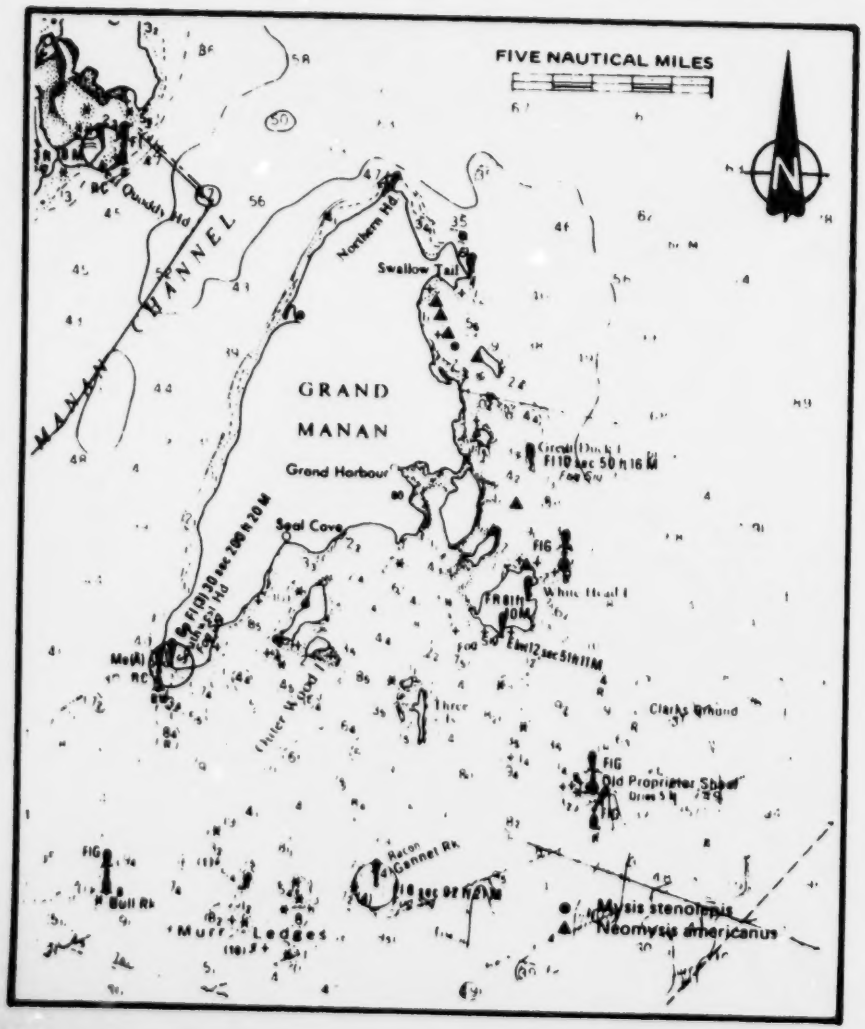
Distribution and Abundance - (Figure 7.14.1) - T1-C, T2-C, D2-C, D3-C-A, D5-C, D7-A, D13-P-C, D18-P, D20-P, D31-P, D43-P-C, D44-C, D46-P, D47-P-C.

7.14.1
DISTRIBUTION OF SHRIMP

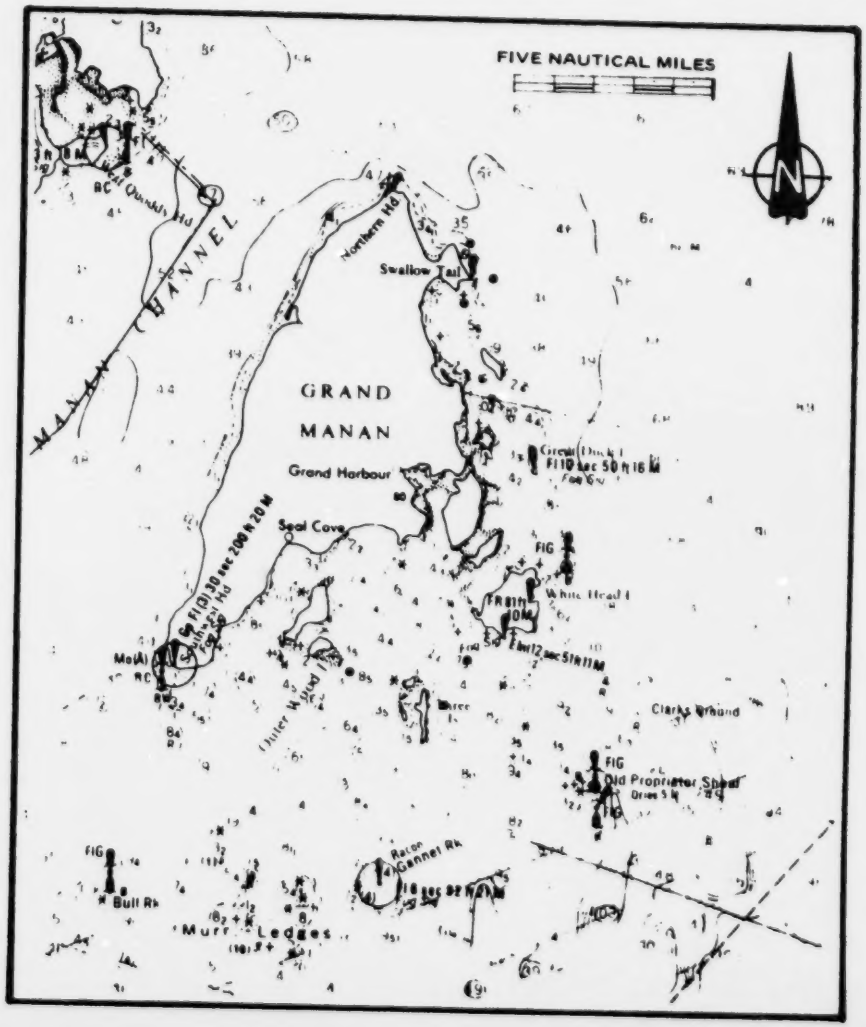
THE GRAND MANAN ARCHIPELAGO



7.14.2
DISTRIBUTION OF MYSIDS THE GRAND MANAN ARCHIPELAGO

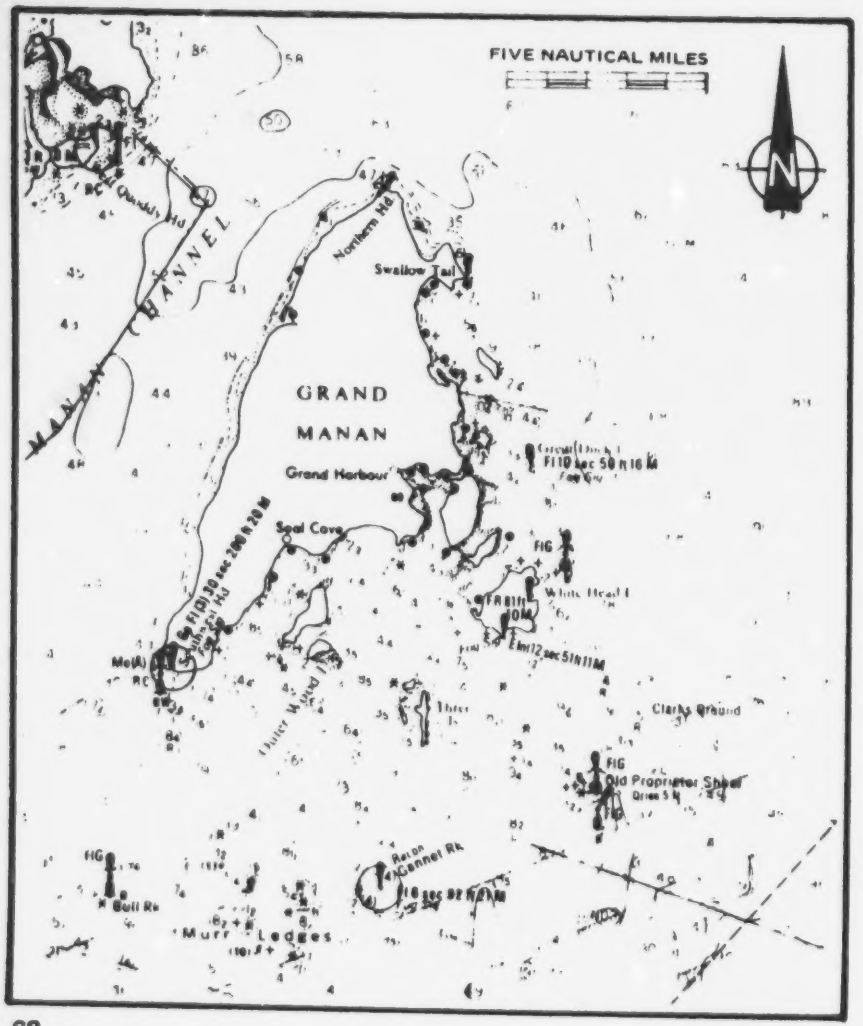


7.14.3
DISTRIBUTION OF LOBSTER THE GRAND MANAN ARCHIPELAGO



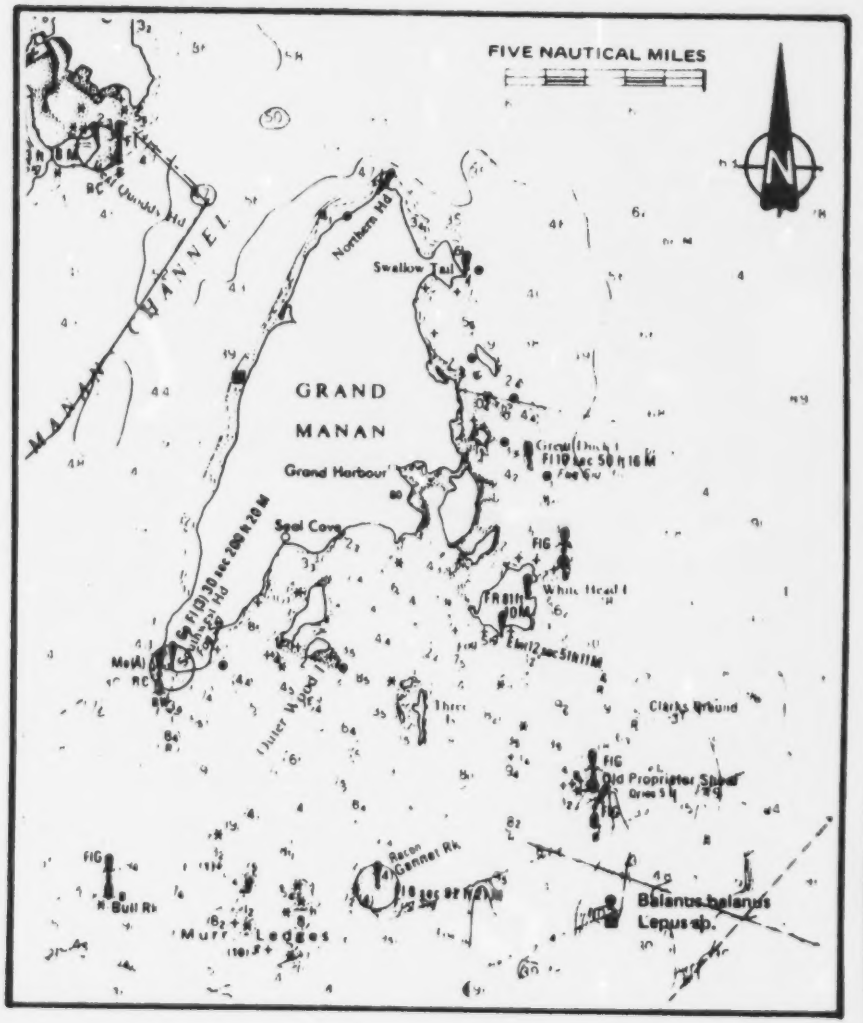
7.14.4
DISTRIBUTION OF THE COMMON BARNACLE

THE GRAND MANAN ARCHIPELAGO



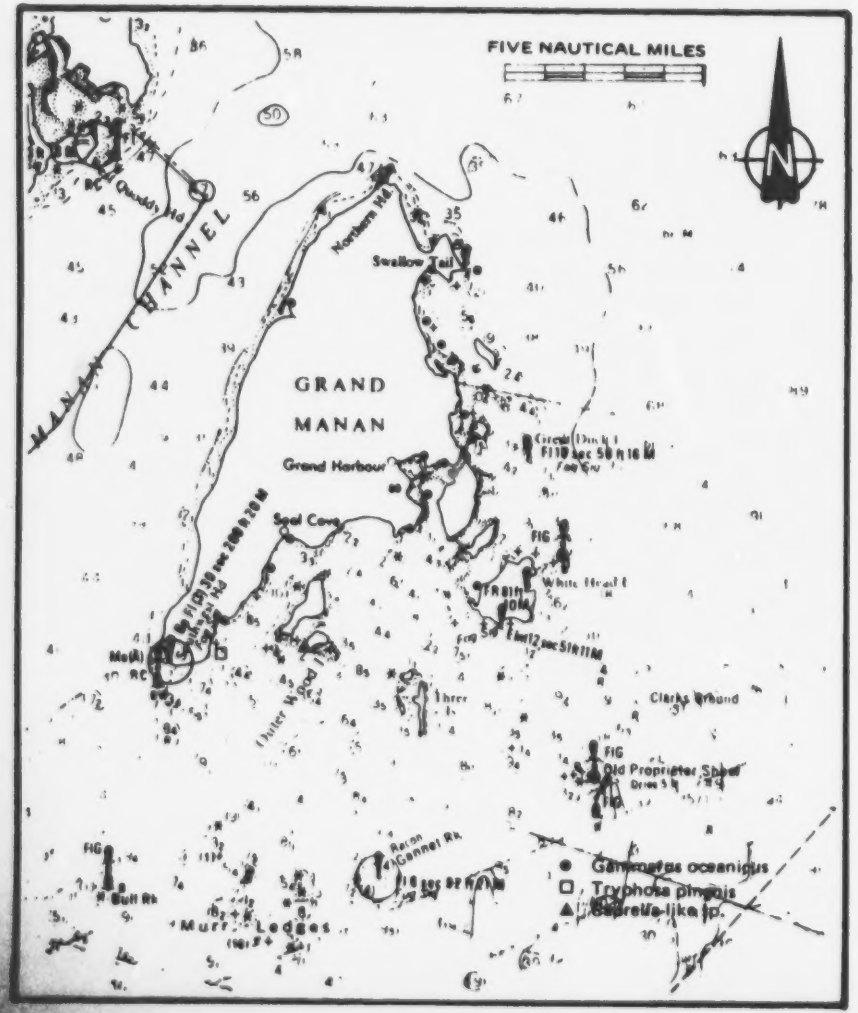
7.14.5
DISTRIBUTION OF THE BARNACLES
B. BALANUS AND LEPUS

THE GRAND MANAN ARCHIPELAGO



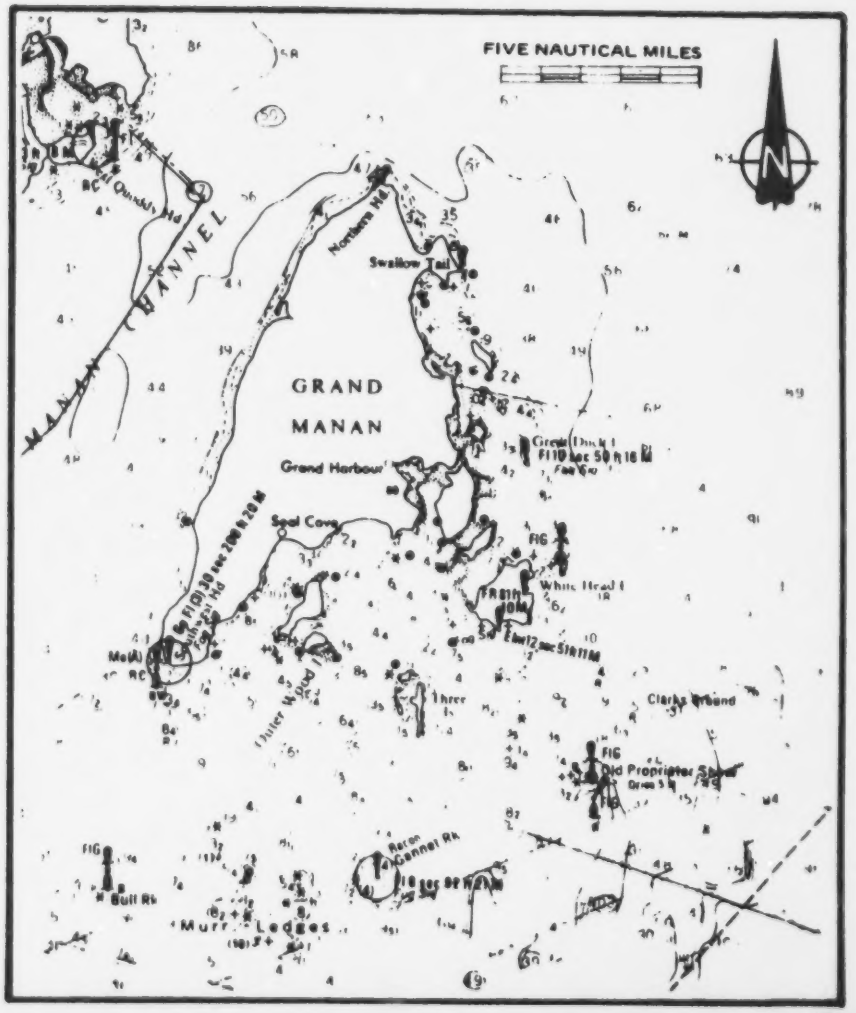
7.14.6
DISTRIBUTION OF AMPHIPODS AND CAPRELLIDS

THE GRAND MANAN ARCHIPELAGO



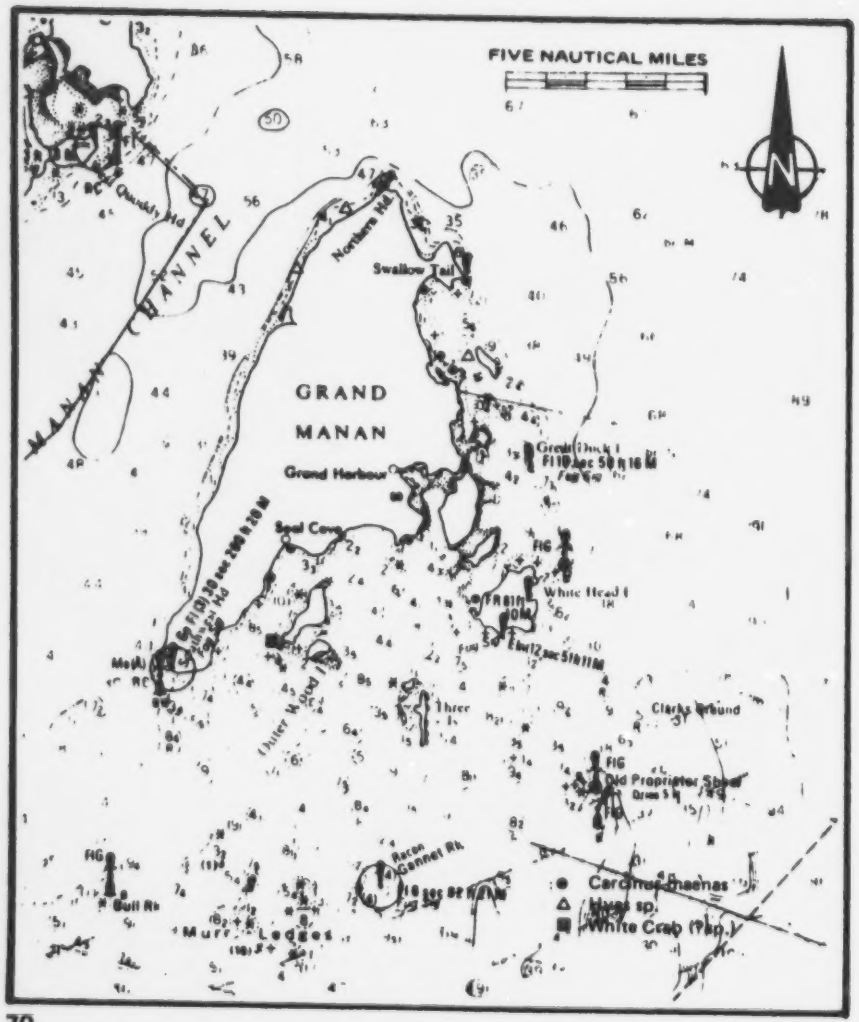
7.14.7
DISTRIBUTION OF THE ROCK CRAB

THE GRAND MANAN ARCHIPELAGO



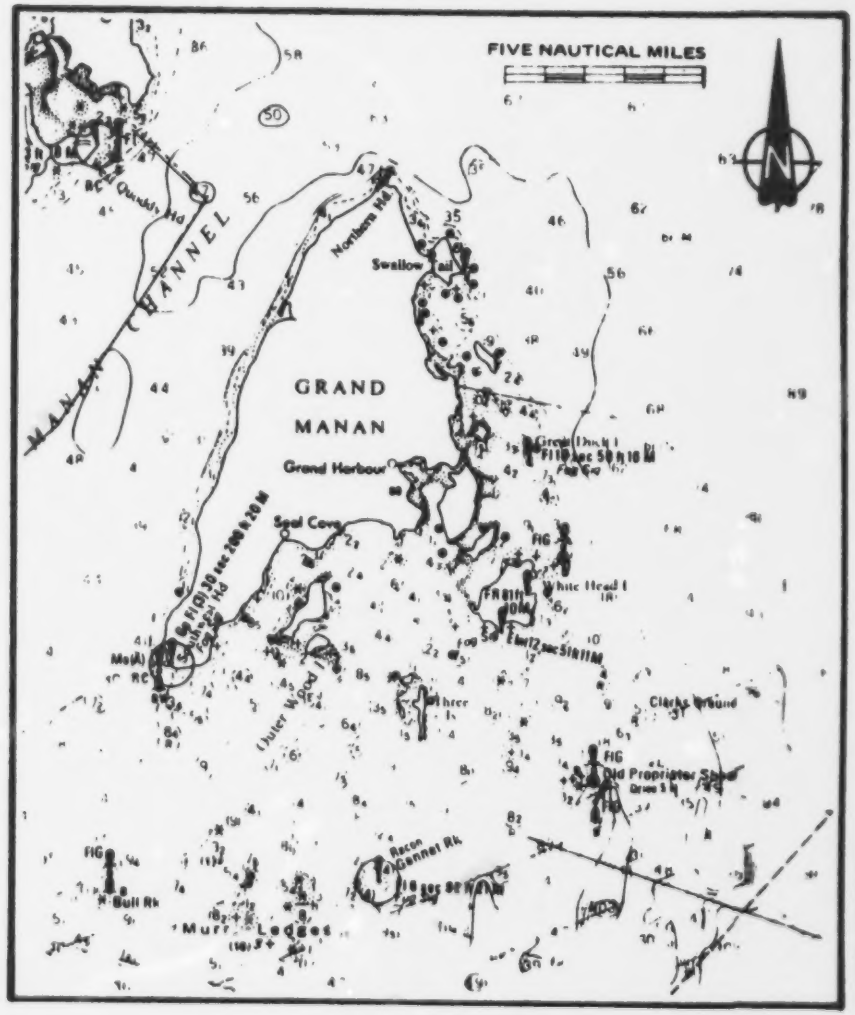
7.14.8
DISTRIBUTION OF VARIOUS CRABS

THE GRAND MANAN ARCHIPELAGO



7.14.9
DISTRIBUTION OF THE HERMIT CRAB

THE GRAND MANAN ARCHIPELAGO



ECHINODERMATA

(STARFISH, URCHINS, ETC.)

7.15 INTRODUCTION

Numerous species of Echinoderms occur in the Bay of Fundy. Some species occur intertidally but most are subtidal. In the study area, all major species were represented on a variety of substrates.

Sea urchins are the only species in this group with commercial value. Potential also exists for pharmaceutical utilization of chemicals extracted from certain species.

7.16 ANNOTATED LIST OF SPECIES

7.16.1 SCARLET PSOLUS/*Psolus fabricii* (Duben and Koren)

Description - Dorsal sides covered with scales; ten tentacles on anterior end; large sole with tube feet for attachment to rock; bright red, sometimes darkened by mud.

Habitat - Occurs subtidally on rock from low water to 50 feet.

Distribution and Abundance - (Figure 7.16.1) - T1-P, T2-P, D44-P, D47-P, D3-P, D4-P, D18-C, D19-C.

7.16.2 NORTHERN SEA CUCUMBER/*Cucumaria frondosa* (Gunnerus)

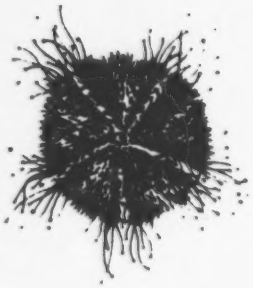
Description - Cylindrical body with tube feet in five longitudinal lines; ten branching tentacles on anterior end; to 12 inches in length - black, grey, occasionally yellow or orange.

Habitat - Occurs subtidally on various substrates from 10 feet to depths in excess of 100 feet.

Distribution and Abundance - (Figure 7.16.1) - T3-P, T5-P, D12-C, D18-P.

BRITTLESTAR

7.16.3 SEA URCHINS/*Strongylocentrotus droebachiensis* (Muller)



Description - Circular with many sharp spines; to 4 inches in diameter; green.

Habitat - Occurs intertidally in tide pools and near the low water mark. Subtidally from low water to 50 feet and more, but most abundant to 20 feet. Occurs on various substrates.

Commercial Utilization - Good markets exist for sea urchins roe and development of this fishery is beginning in New Brunswick.

Distribution and Abundance - (Figure 7.16.2) - T1-P, T2-P, T3-C-A, T4-A, T5-A, T6-C-A, T7-P-A, T8-P-C, T9-P-C, D1-P, D2-A, D3-C, D4-C, D5-C, D6-C-A, D7-C, D10-C, D11-P, D12-P, D13-C, D14-C, D15-C, D16-C, D17-A, D18-A, D19-C, D20-C, D21-A, D22-C, D23-A, D26-A, D27-A, D29-C, D31-C, D32-P, D36-P, D38-C, D39-P-C, D40-C, D41-P, D42-P, D43-P, D44-P, D45-P, D46-P, D47-P-C, S1-C, S6-P.

7.16.4 SAND DOLLARS/*Echinarachnius parma* (Lamark)

Description - Flat; circular; five petal-shaped rays on upper side; to 4 inches; dark brown to black.

Habitat - Occurs intertidally and subtidally on sand bottom to depths of 20 feet.

Distribution and Abundance - (Figure 7.16.3) - D8-A, D9-P, D23-A.

7.16.5 BLOODSTAR/*Henricia sp.*

Description - Five rayed; arms rounded; smooth; to 6 inches; red, orange, yellow.

Habitat - Occurs near low water intertidally and subtidally to depths in excess of 100 feet on rocky substrate.

Distribution and Abundance - (Figure 7.16.3) - T1-P, T4-P, T8-P, T9-P, D4-P-C, D12-P, D14-P, D18-P, D19-P, D31-P, D39-P, D40-P, D43-P, D44-C, D47-P-C.

7.16.6 COMMON STARFISH/*Asterias vulgaris* (Verrill)

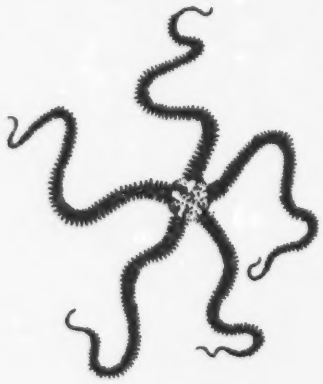
Description - Five rayed; moderately spiny; rarely to 20 inches;orange, yellow.

Habitat - Occurs intertidally near low water and subtidally to 50 feet on various substrates.

Distribution and Abundance - (Figure 7.16.4) - T4-C, T5-P, T6-C, T8-P, T9-P, D3-P, D4-P, D6-P, D10-P, D11-P, D12-P, D13-P, D14-P, D16-P, D19-C, D21-P, D29-P.

A. forbesi - D26-P-C.

7.16.7 BRITTLESTAR/*Ophiopholis aculeata* (Linnaeus)



Description - Five delicate rays emerging from a circular disc; to 6 inches in diameter; various combinations of dark red and white.

Habitat - Occurs intertidally in tide pools and near low water. Subtidally under rocks and in ledge to depths in excess of 100 ft.

Distribution and Abundance - (Figure 7.16.5) - T1-P, T2-C, T4-C, T5-P-C, T6-P, D2-A, D3-A, D4-C, D7-A, D10-P, D11-P, D12-P, D13-C, D14-C, D15-P, D17-P, D18-C, D18-C, D20-C, D21-P, D22-P, D29-C, D31-P, D38-P, D39-C, D42-P, D43-P, D36-P, D47-P-C.

7.16.8 STARFISH/*Leptasterias sp.*

Description - Five rays; to 2 inches; dark green, dark brown.

Habitat - Occurs intertidally under rocks and in crevices near the low water mark.

Distribution and Abundance - (Figure 7.16.6) - D2-C, D3-C, D4-P-C, D5-P, D13-C, D15-P, D16-P, D18-P, D19-C, D20-P, D21-P, D29-P, D31-P, D39-P, D40-P, D42-P, D44-P, D45-P, D46-P, S1-C, S5-P, S21-P, S25-C, S26-P.

7.16.9 SEA CUCUMBER/*Leptosynapta*

Description - Cylindrical cucumber; to 3½ inches; transparent with some white and pinkish shades.

Habitat - Occurs intertidally in sand, gravel ; occasionally in mud, and under rocks. Occurs subtidally in similar circumstances to 80 meters.

Distribution and Abundance - S21-P.

7.16.10 CAUDINA/*Caudina arenata* Gould

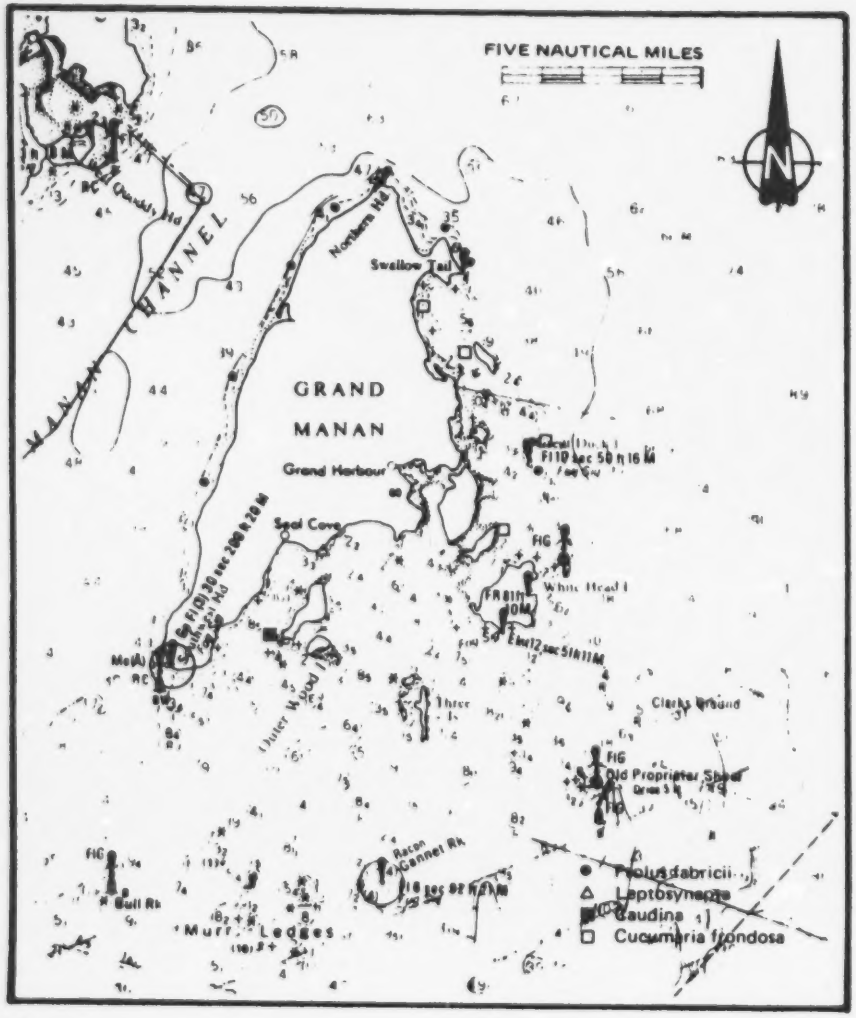
Description - A gray cylindrical Molpadonia which tapers posteriorly to a pointed tail; 4 to 7 inches.

Habitat - Usually taken from mud bottom in deep water.

Distribution and Abundance - (Figure 7.16.1) - D37-P.

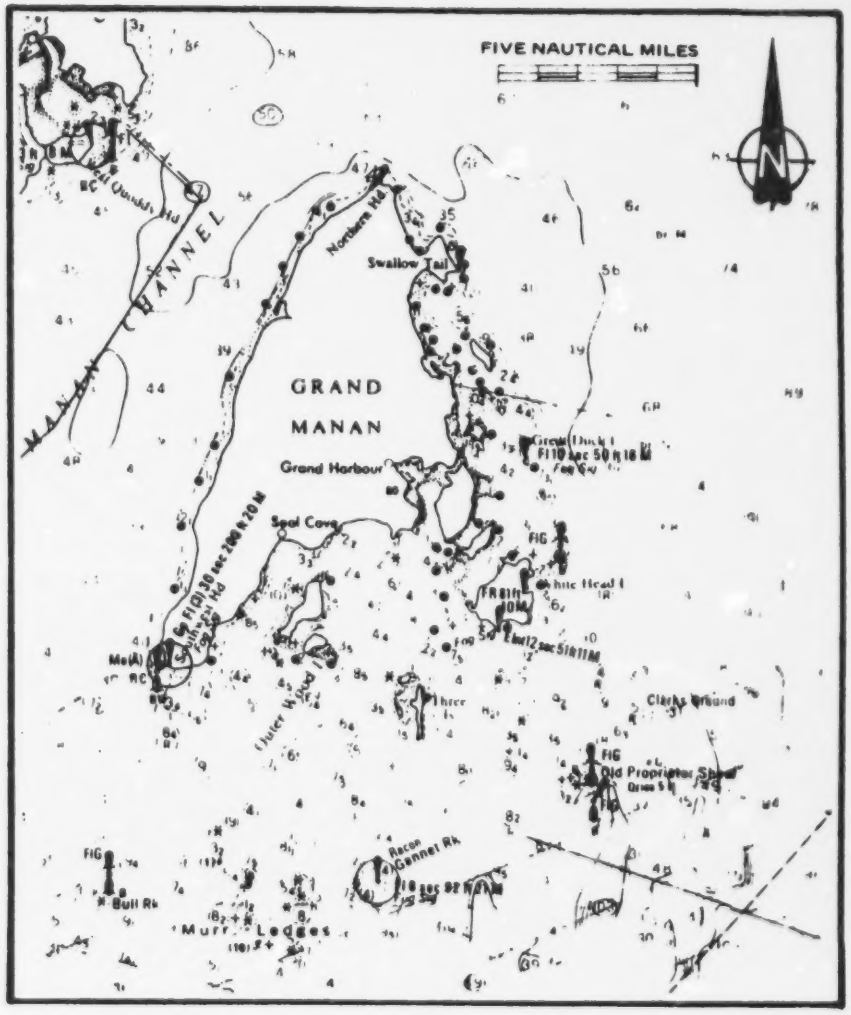
7.16.1
DISTRIBUTION OF VARIOUS ECHINODERMS

THE GRAND MANAN ARCHIPELAGO

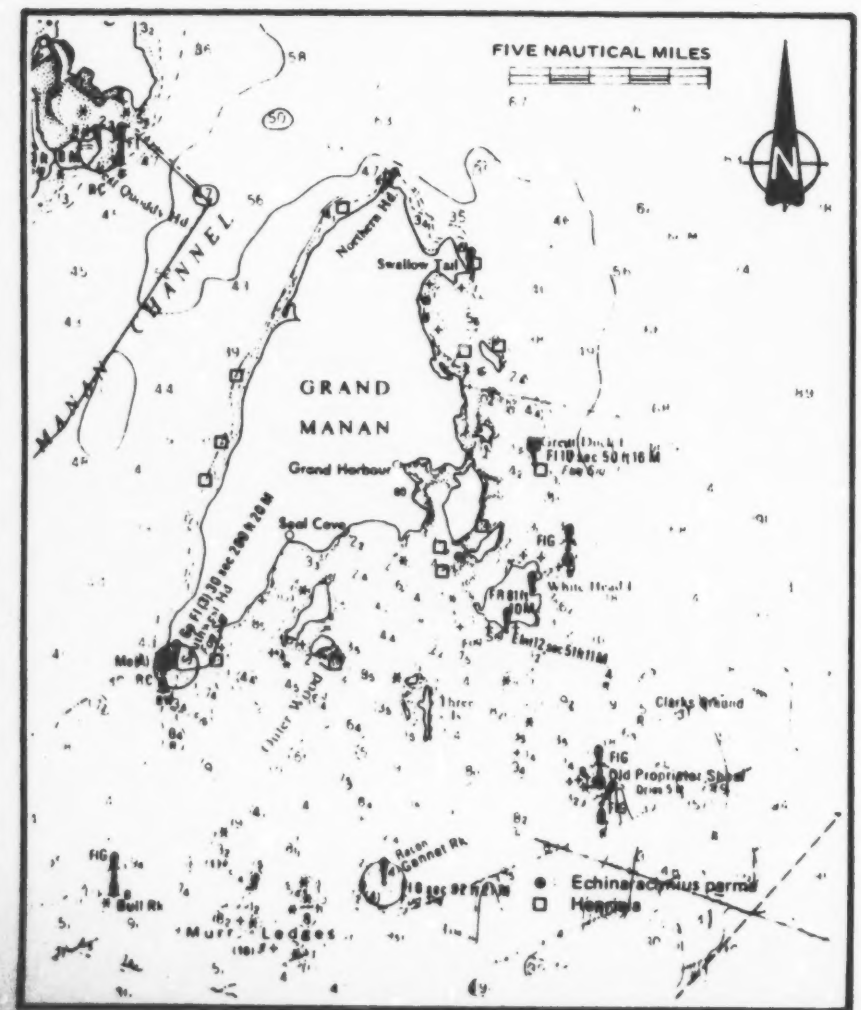


7.16.2
DISTRIBUTION OF THE SEA URCHIN

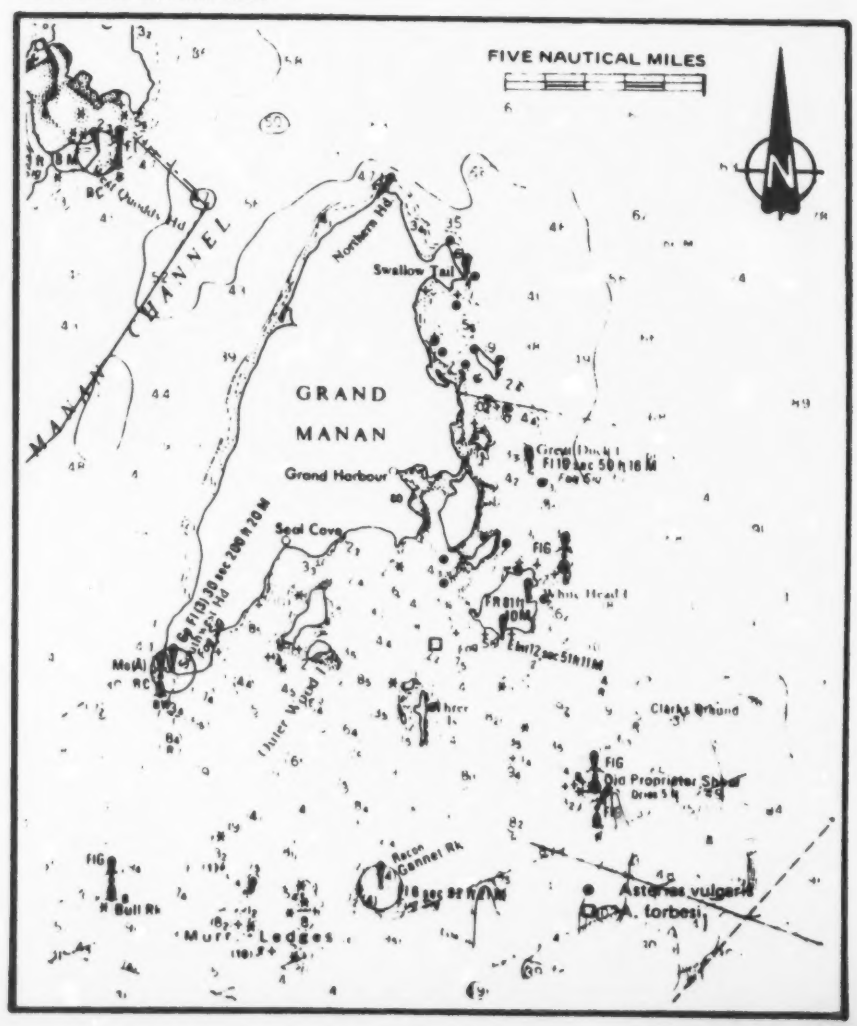
THE GRAND MANAN ARCHIPELAGO



7.16.3
DISTRIBUTION OF SAND DOLLARS AND BLOODSTARS THE GRAND MANAN ARCHIPELAGO

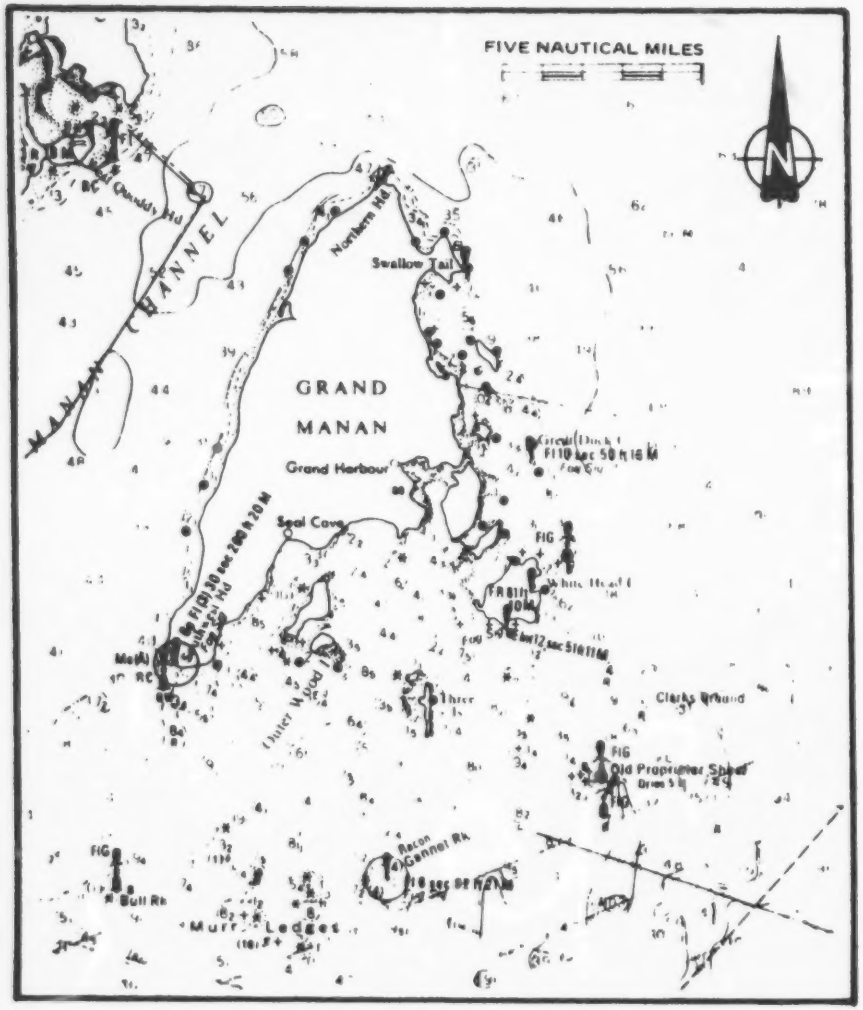


7.16.4
DISTRIBUTION OF THE COMMON STARFISH THE GRAND MANAN ARCHIPELAGO



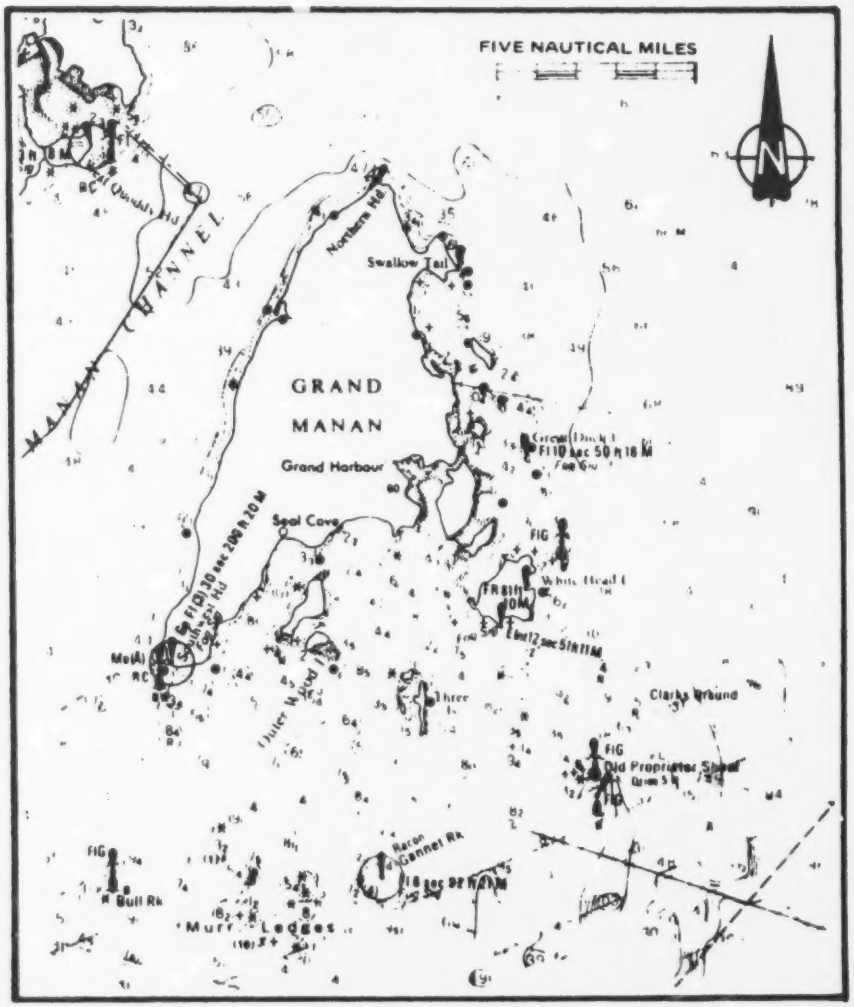
7.16.5
DISTRIBUTION OF THE BRITTLESTAR

THE GRAND MANAN ARCHIPELAGO



7.16.6
DISTRIBUTION OF THE STARFISH LEPTASTERIAS Sp.

THE GRAND MANAN ARCHIPELAGO



PROTOCHORDATA
(SEA SQUIRTS, ACORN WORMS, ETC.)

7.17 INTRODUCTION

A limited number of species of protochordates occur in the Bay of Fundy. With the exception of the Acorn worm which occurs in mud flats, and a few sea squirts that occur under rocks in tide pools, protochordata are found subtidally on rock, mud or twine.

While potential exists for the pharmaceutical utilization of chemicals extracted from certain species, the only commercial use at the present time is as a research animal.

7.18 ANNOTATED LIST OF SPECIES

7.18.1 SEA POTATO/*Boltenia ovifera* (Linnaeus)

Description - Egg-shaped body on slender stalk to 18 inches; openings on body for filter feeding; orange-red; often encrusted with Bryozoa and other tunicates.

Habitat - Occurs subtidally from low water to well over 100 feet; on rock; also common on weir posts, shells of scallops and horse mussels.

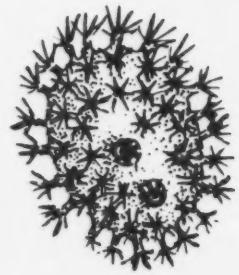
Distribution and Abundance (Figure 7.18.1) - D19-A.

7.18.2 *Boltenia echinata* (Linnaeus)

Description - Cactus-like tubercles covering unstalked body; to 1 inch diameter; pink-red.

Habitat - Occurs subtidally under rocks, on other tunicates and on shells; from low water to over 100 feet.

Distribution and Abundance - (Figure 7.18.1) - T4-P, D44-P.



BOLTENIA ECHINATA

SEA POTATO

7.18.3 SEA PEACH/*Halocynthia pyriformis* (Rothke)

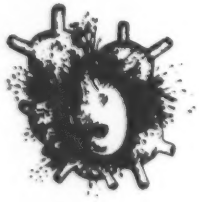
Description - Barrel-shaped; to 4 inches; two apertures on top; orange, white.

Habitat - Occurs attached to the upper surface of rocks, ledge, shells etc. from low water to depths in excess of 100 feet.

Commercial Utilization - Used as research animal by cancer researchers.

Distribution and Abundance - (Figure 7.18.1) - T4-P, T5-P, D19-P.

7.18.4 SEA GRAPE/*Molgula sp.*

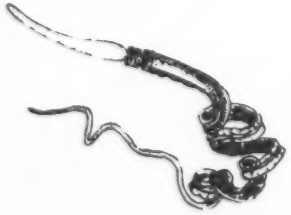


Description - A round white, translucent sea squirt resembling grapes.

Habitat - Wharves, floats,pilings. Subtidally on the undersurface of rocks.

Distribution and Abundance - (Figure 7.18.1) - T5-P, S21-C.

7.18.5 ACORN WORM/*Sacccoglossus sp.*



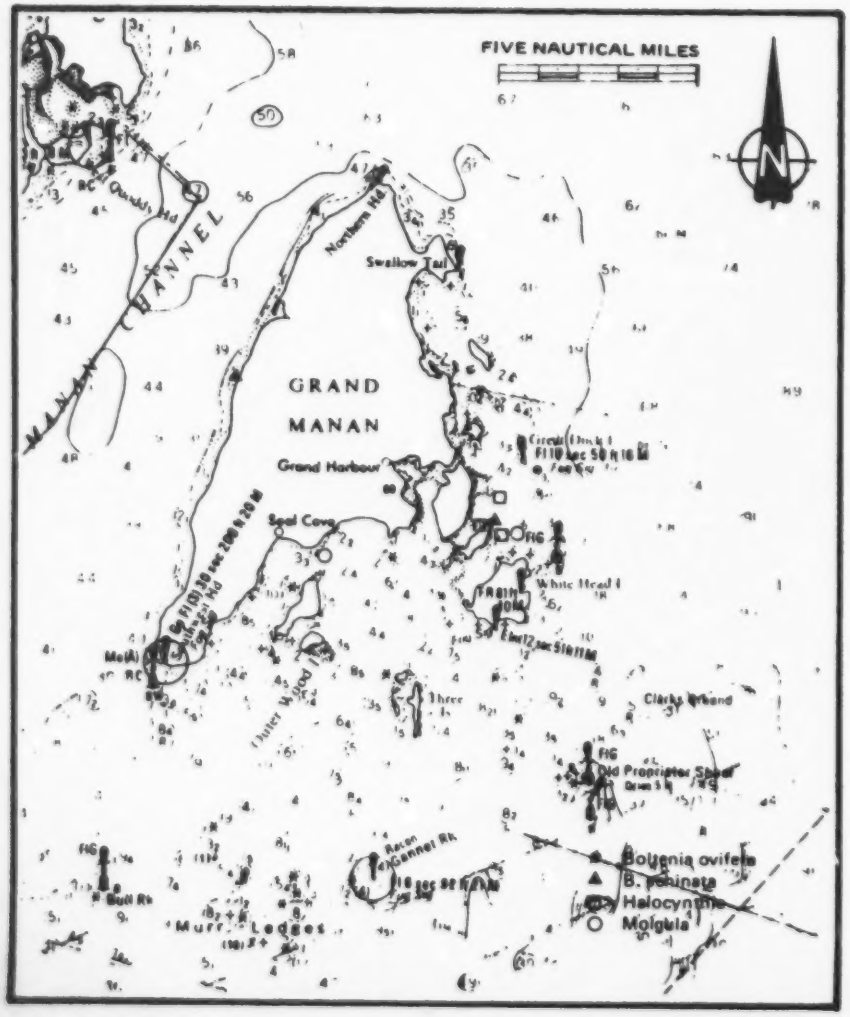
Description - Resembles a worm. Body brownish; proboscis yellow or yellow orange.

Habitat - Occurs intertidally in mud.

Distribution and Abundance - (Figure 7.18.2) S9-P, S11-P-C, S12-P, S14-P-A, S15-C, S16-C-A.

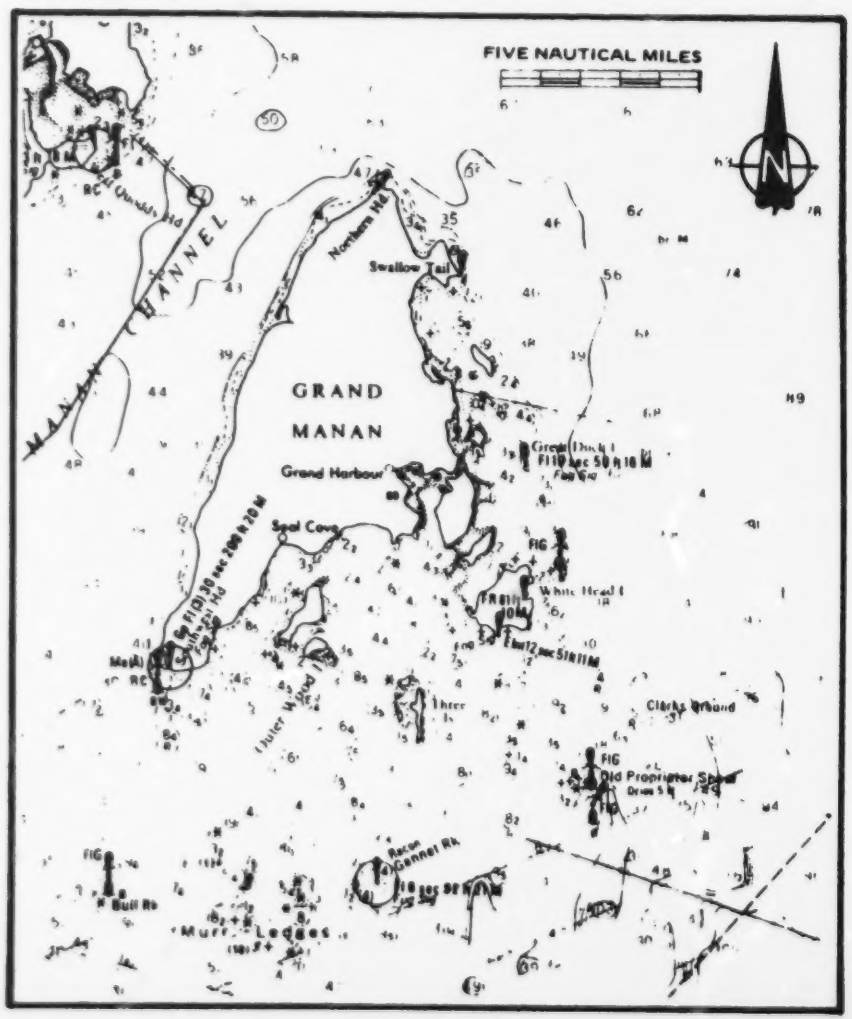
7.18.1
DISTRIBUTION OF SEA SQUIRTS

THE GRAND MANAN ARCHIPELAGO



7.18.2
DISTRIBUTION OF THE ACORN WORM

THE GRAND MANAN ARCHIPELAGO



7.19 INTRODUCTION

Principal Commercial activities in the area revolve around the fishery (See Section 9). During the course of this survey, site records were kept for all fish species encountered. Other species which occur in the area but were not recorded, are given in Table 7.19.1 (For species descriptions see Leim and Scott (1966)).

7.20 ANNOTATED LIST OF SPECIES

FIGURE 7.20.1

LUMPFISH/*Cyclopterus lumpus* Linnaeus
Distribution and Abundance - T4-P, T6-P, T9-P, D19-P, D24-P, D35-P, D46-P.

ATLANTIC COD/*Gadus morhua* (Linnaeus)
Distribution and Abundance - D18-C.

HAKE/*Urophycis sp. (?)*
Distribution and Abundance - D18-9.

TOMCOD/*Microgadus tomcod* (Walbaum)
Distribution and Abundance - D41-P.

FIGURE 7.20.2

HARBOUR POLLACK/*Pollachius virens* (Linnaeus)
Distribution and Abundance - T5-C, T6-P, T8-C, D1-P, D3-A, D4-P, D14-P, D18-P, D19-C, D27-A, D38-A, D44-A, S13-P.

FIGURE 7.20.3

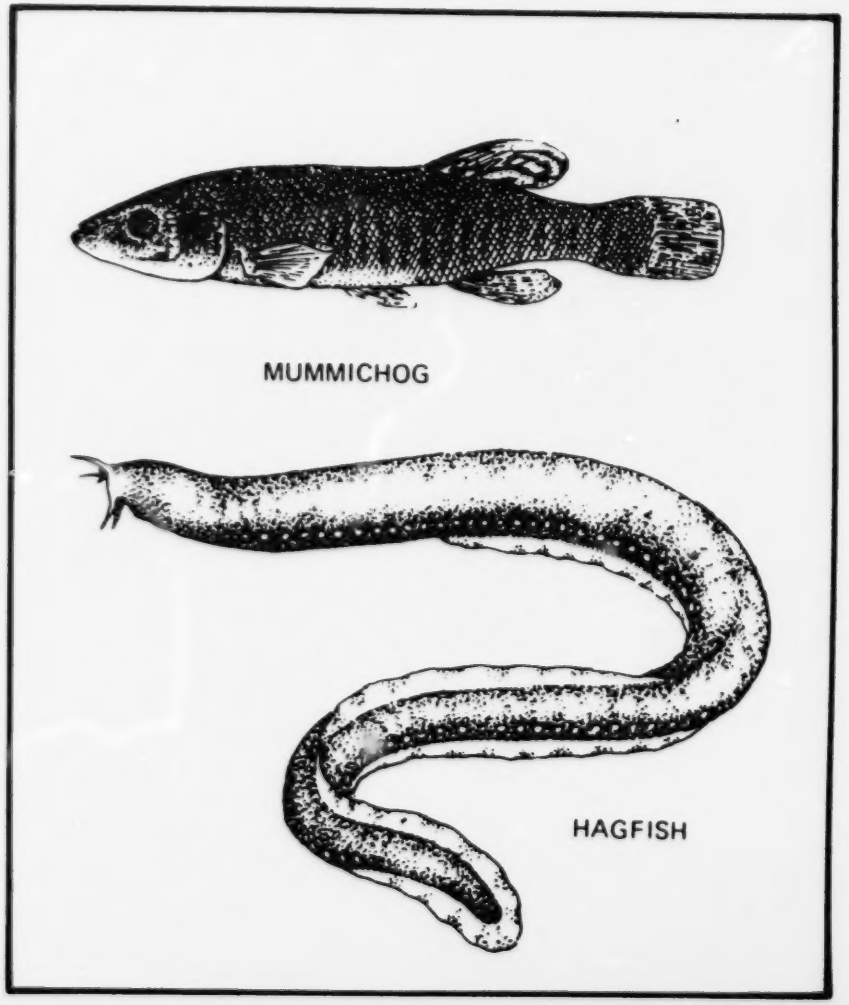
CUNNER/*Tautogolabrus adspersus* (Walbaum)
Distribution and Abundance - D44-P.

SERRANID
Distribution and Abundance - D3-P, D4-A, D5-P. (Note: Conversation with Dr. B. Scott, HML, St. Andrews led to the conclusion that these fish may be a member of the Serranidae (groupers) previously unrecorded in the Bay of Fundy).

PERCH-LIKE FISH
Distribution and Abundance - D18-P.

FIGURE 7.20.4

FLOUNDER/*Pseudopleuronectes sp. (?)*
Distribution and Abundance - D1-P, D8-C, D9-P, D36-P, D41-P.



GOOSEFISH/*Lophius americanus* Valenciennes
Distribution and Abundance - S13-P.

FIGURE 7.20.5

SEARAVEN/*Hemitripterus americanus* (Gmelin)
Distribution and Abundance - T7-P, D5-P, D7-P, D14-P, D19-P, D37-P, D39-P, D47-P.

SCULPIN/*Myoxocephalus sp.*
Distribution and Abundance - T6-P, T8-P, D4-P, D5-P, D8-P, D10-P, D16-P, D21-P, D25-P.

ATLANTIC SEASNAIL/*Liparis americanus* (Jordan and Evermann)
Distribution and Abundance - D15-P.

FIGURE 7.20.6

BLENNY OR ROCK GUNNEL/*Pholis gunnellus* (Linnaeus)
Distribution and Abundance - T4-C, T7-P, T8-P, T9-P, D3-P, D4-C, D14-P, D18-P, T1-P, D6-P, D7-P, D10-P, D13-C. D21-C, D40-C, D41-P, D46-P, S1-P, S2-P, S6-P-A, S8-C, S19-P-C, S21-C, S22-C, S23-P. (Note: several species may be included here; *P. gunnellus* and subtidal fish of similar form observed but not captured).

FIGURE 7.20.7

STICKLEBACKS/*Apeltes quadracus* (Mitchill)
Gasterosteus aculeatus Linnaeus
Distribution and Abundance -
A. quadracus - S20-P, S25-P, S10-P.
G. aculeatus - S11-P-C, S13-P, S9-C, S12-C.

FIGURE 7.20.8

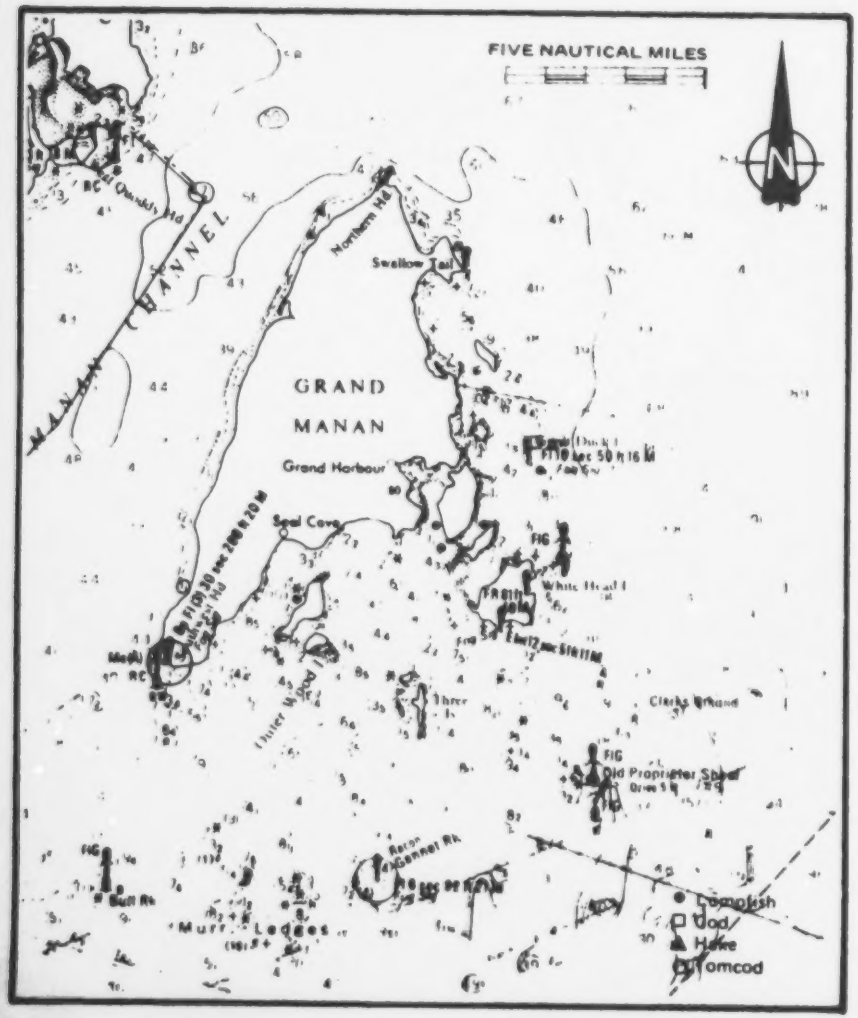
SKATE/*Raja sp.*
Distribution and Abundance - D5-P, D36-P.

AMERICAN EEL/*Anguilla rostrata* (LeSeur)
Distribution and Abundance - S12-P, S18-P.

MUMMICHOG/*Fundulus heteroclitus* (Linnaeus)
Distribution and Abundance - S7-P-A, S20-C.

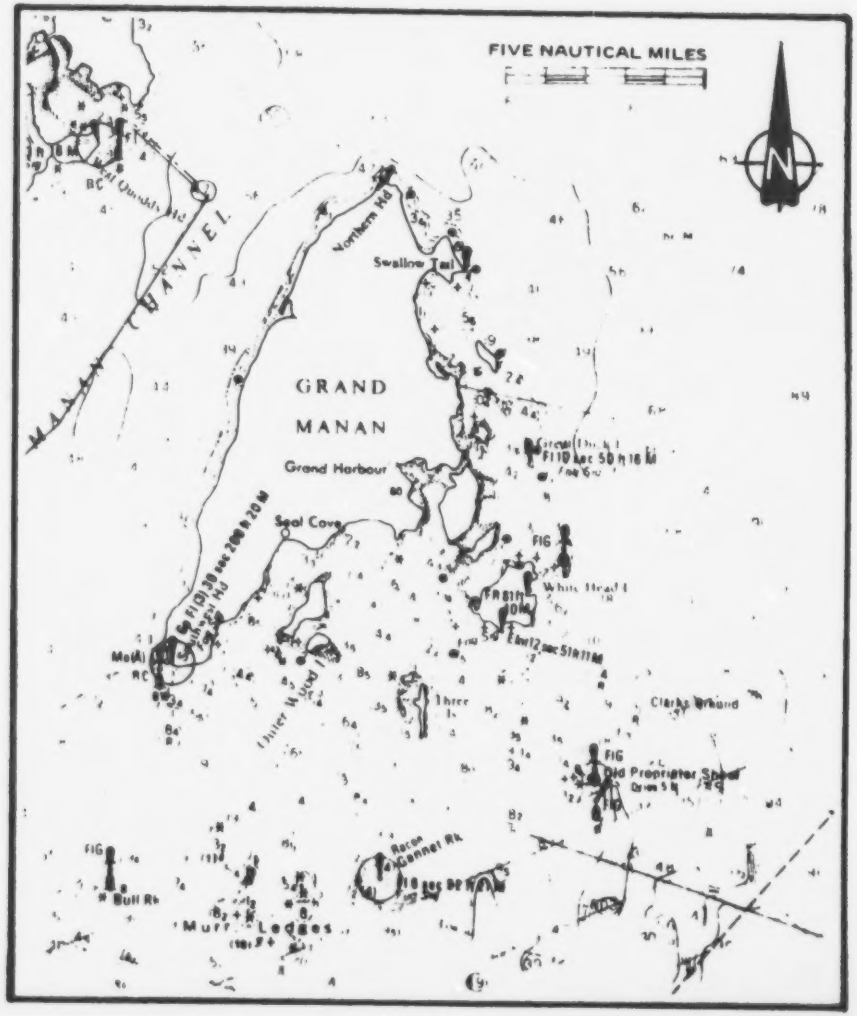
7.20.1
DISTRIBUTION OF LUMPFISH, COD, HAKE AND TOMCOD

THE GRAND MANAN ARCHIPELAGO



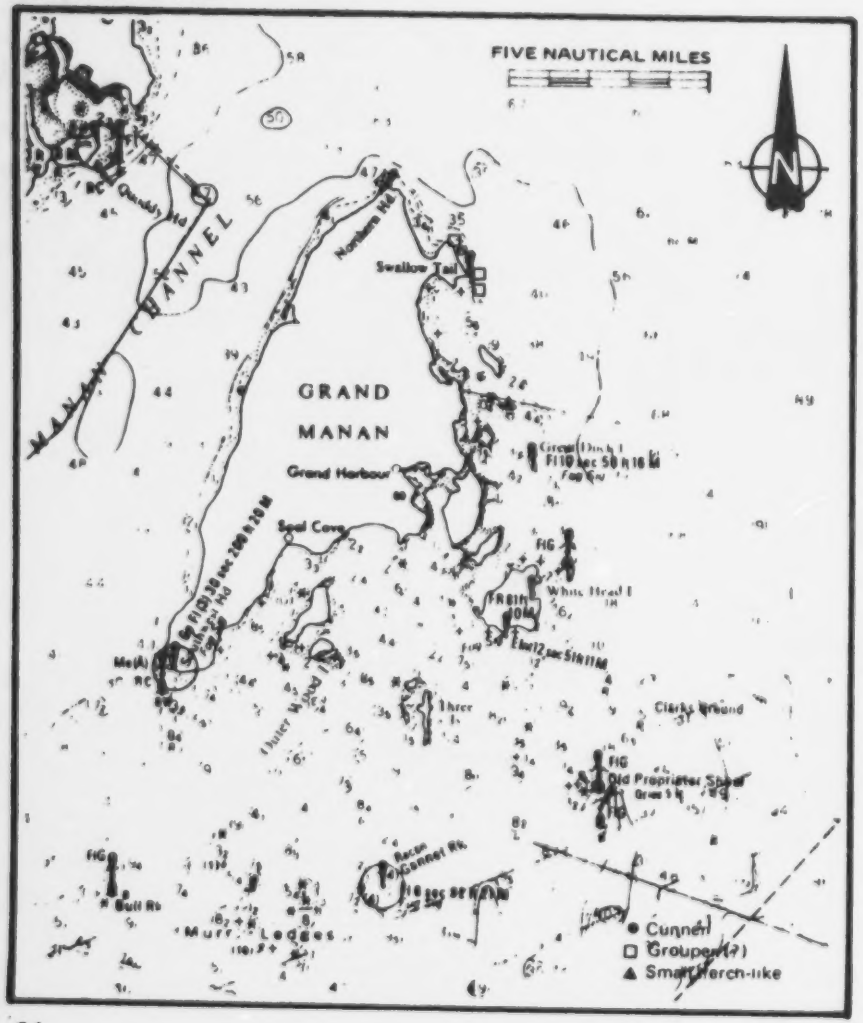
7.20.2
DISTRIBUTION OF HARBOUR POLLACK

THE GRAND MANAN ARCHIPELAGO



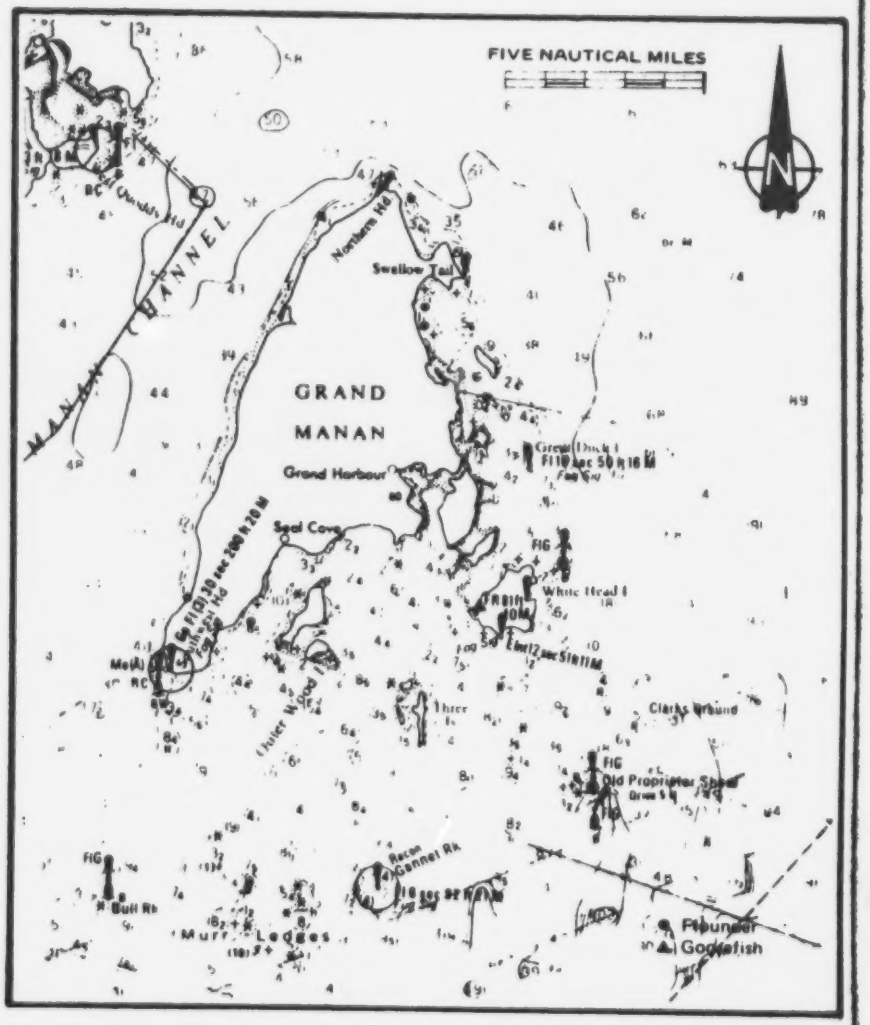
7.20.3
DISTRIBUTION OF CUNNER, SERRANID (?) PERCH-LIKE FISH

THE GRAND MANAN ARCHIPELAGO

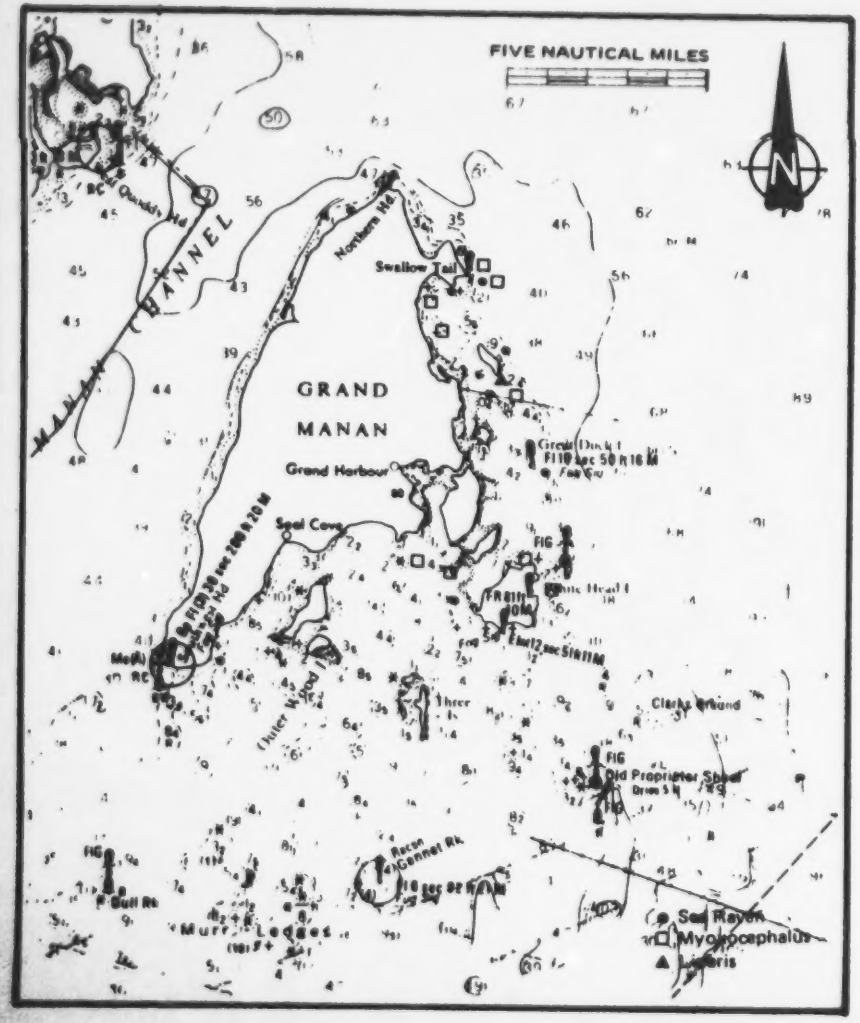


7.20.4
DISTRIBUTION OF FLOUNDER, GOOSEFISH

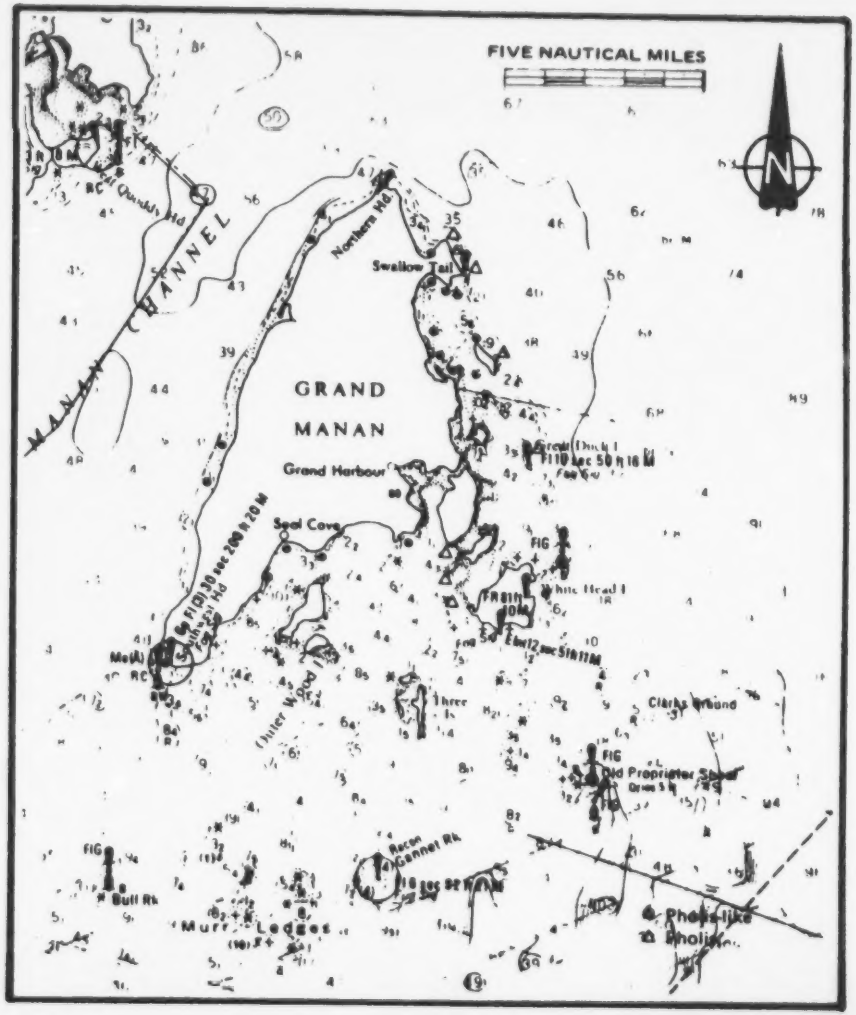
THE GRAND MANAN ARCHIPELAGO



7.20.5
DISTRIBUTION OF SEA RAVEN, SCULPIN AND SEASNAIL THE GRAND MANAN ARCHIPELAGO

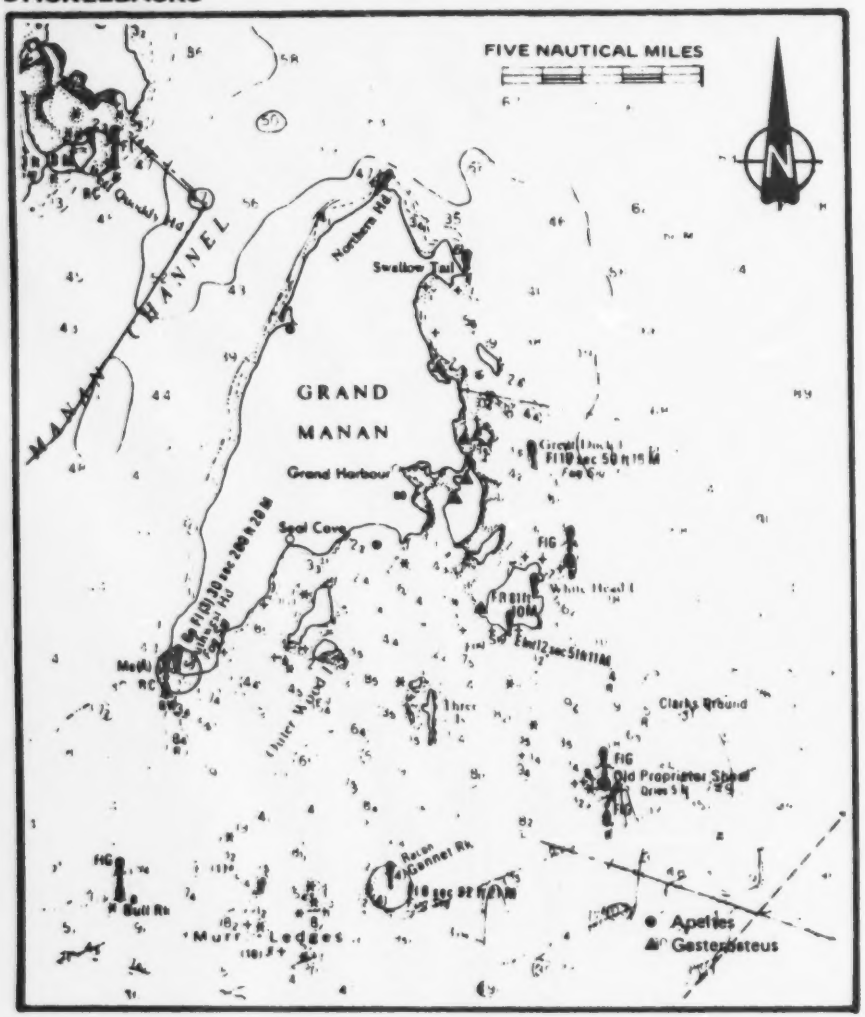


7.20.6
DISTRIBUTION OF ROCK GUNNEL AND SIMILAR SPECIES THE GRAND MANAN ARCHIPELAGO



7.20.7
DISTRIBUTION OF STICKLEBACKS

THE GRAND MANAN ARCHIPELAGO



7.20.8
DISTRIBUTION OF SKATE, EEL AND MUMMICHOG

THE GRAND MANAN ARCHIPELAGO

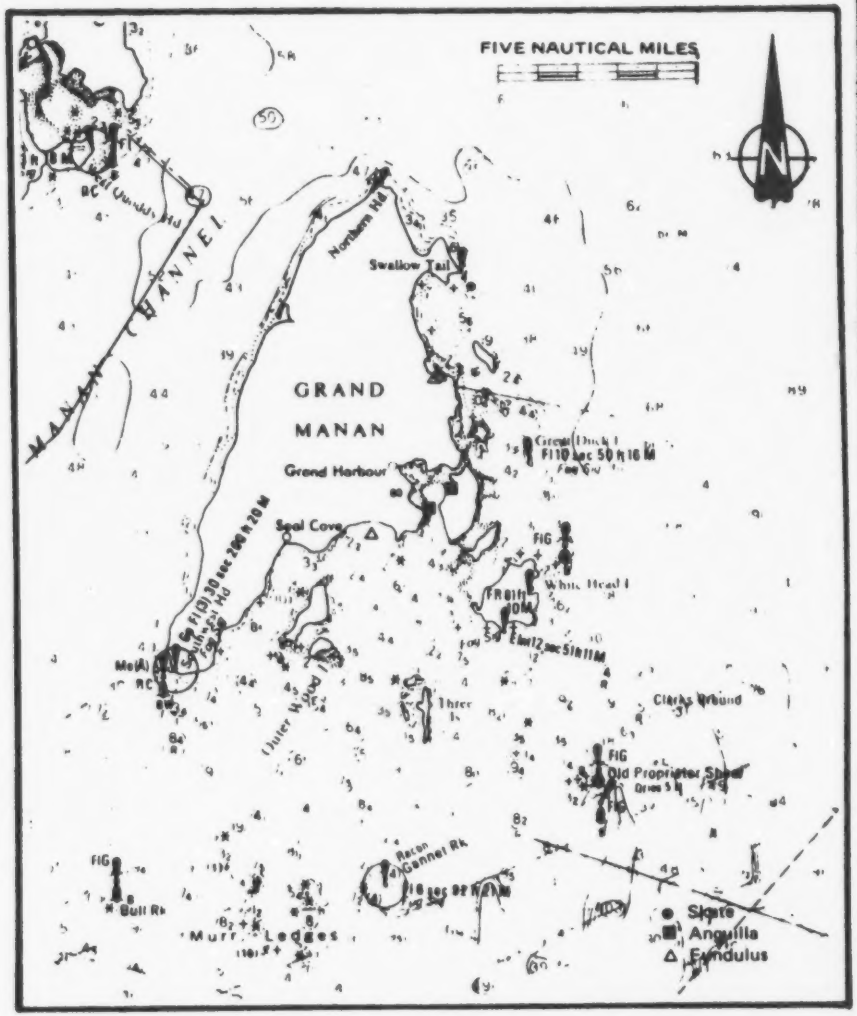


TABLE 7.19.1 FISHES RECORDED IN THE STUDY AREA AND VICINITY

MARSIPOBRANCHII

Myxine glutinosa (Hagfish)
Petromyzon marinus (Lamprey)

SELACHII

Carcharias taurus (Sand Shark)*
Alopias vulpinus (Thresher Shark)*
Carcharodon carcharias (White Shark)
Lamna nasus (Porbeagle)
Mustelus canis (Smooth Dogfish)*
Rhizoprionodon terraenovae (Atlantic Sharpnose Shark)*
Somniosus microcephalus (Greenland Shark)
Squalus acanthus (Spiny Dogfish)
Raja erinacea (Little Skate)
R. laevis (Barndoor Skate)
R. ocellata (Winter Skate)
R. radiata (Thorny Skate)
Torpedo nobiliana (Atlantic Torpedo)

PISCES

Acipenser oxyrhynchus (Atlantic Sturgeon)
Alosa pseudoharengus (Alewife)
A. sapidissima (American Shad)
Brevoortia tyrannus (Menhaden)*
Clupea harengus (Herring)
Etrumeus sadina (Round Herring)*
Coregonus clupeaformis (Lake Whitefish)*
Salmo salar (Atlantic Salmon)
Salvelinus fontinalis (Brook Trout)
Mallotus villosus (Capelin)*
Osmerus mordax (Smelt)
Mauroclicus muelleri (Muller's Pearlsides)*
Anguilla rostrata (American Eel)
Conger oceanicus (Conger Eel-larval)*
Scomberesox saurus (Atlantic Saury)*
Hyporhamphus sp. (Common Halfbeak)*
Fundulus heteroclitus (Mummichog)
Syngnathus fuscus (Northern Pipefish)
Apeltes quadracus (Fourspine Stickleback)
Gasterosteus aculeatus (Threespine Stickleback)
G. wheatlandi (Blackspotted Stickleback)
Pungitius pungitius (Ninespine Stickleback)
Brosme brosme (Cusk)
Enchelyopus cimbrius (Fourbeard rockling)
Gadus morhua (Atlantic Cod)
Melanogrammus aeglefinus (Haddock)
Merluccius bilinearis (Silver Hake)
Microgaddus tomcod (Atlantic Tomcod)
Pollachius virens (Pollock)
Urophycis chuss (Squirrel Hake)
Nezumia bairdi (Marlin Spike)*
Zenopsis ocellata (American John Dory)*
Roccus americanus (White Perch)
R. saxatilis (Striped Bass)
Stenotomus chrysops (Scup)*
Tautoga onitis (Tautog)*
Tautogolabrus adspersus (Cunner)
Ammodytes americanus (American Sand Lance)
Sarda sarda (Atlantic Bonito)*
Scomber colias (Chub Mackerel)
S. scombrus (Atlantic Mackerel)
Thunnus thynnus (Bluefin Tuna)
Anarhichas lupus (Atlantic Wolffish)
A. minor (Spotted Wolffish)*
Pholis gunnellus (Rock Gunnell)
Cryptacanthodes maculatus (Wrymouth)
Lumpenus lumpretaeformis (Snake Blenny)
Ulvaria subbifurcata (Radiated Shanny)
Lycenchelys verrilli (Wolf Eelpout)*
Macrozoarces americanus (Ocean pout)
Poronotus triacanthus (Butterfish)
Menidia menidia (Atlantic Silverside)
Sebastes marinus (Redfish)
Prionotus carolinus (Northern Searobin)
P. evolans (Striped Searobin)*
Artediellus uncinatus (Arctic Hookear Sculpin)*
Gymnocanthus tricuspis (Arctic Staghorn Sculpin)*
Hemitripterus americanus (Atlantic Sea Raven)
Myoxocephalus octodecemspinosus (Longhorn Sculpin)
M. scorpius (Shorthorn Sculpin)
Triglops murrayi (Mailed Sculpin)*
Aspidophoroides monopterygius (Alligatorfish)*
Cyclopterus lumpus (Lumpfish)
Eumicrotremus spinosus (Atlantic Spiny Lumpfish)*
Liparis atlanticus (Atlantic Seasnail)
L. liparis (Striped Seasnail)
Paralichthys dentatus (Summer Flounder)*
P. oblongus (Fourspot Flounder)*
Scophthalmus aquosus (Windowpane)
Glyptocephalus cynoglossus (Witch Flounder)
Hippoglossoides platessoides (American Plaice)
H. hippoglossus (Atlantic Halibut)
Liopsetta putnami (Smooth Flounder)
Pseudopleuronectes americanus (Winter Flounder)
Monacanthus hispidus (Planehead Tilefish)*
Mola mola (Ocean Sunfish)*
Lophius americanus (Monkfish)

* RARE OR OCCASIONAL OCCURRENCE.

BIRDS

7.21 INTRODUCTION

Grand Manan is world renowned for its seabird populations and there have been numerous publications on the avian fauna of the islands. During this study, site records were kept for all species observed. For additional information refer to Squires (1976) and Pettingill (1938).

7.22 ANNOTATED LIST OF SPECIES

7.22.1 DOUBLE-CRESTED CORMORANT/*Phalacrocorax auritus* (Lesson)
Site Records - (Figure 7.22.1) - D9-P, D17-P.

7.22.2 BLACK GUILLEMOT/*Cepphus grylle* (Linnaeus)
Site Records - (Figure 7.22.2) - D17-P, D21-A, D30-A, D37-P, D40-P, D42-P, D46-A.

7.22.3 COMMON EIDER/*Somateria mollissima* (Linnaeus)
Site Records - (Figure 7.22.3) - D17-P, D20-C, D22-A, D30-A, D40-C, D43-P, D45-P, S6-C, S10-A, S14-P, S18-C, S22-P, S23-C.

7.22.4 HERRING GULL/*Larus argentatus* Pontoppidan
Site Records - (Figure 7.22.4) - D13-C, D30-A, S20-C, S22-C.

7.22.5 GREATER BLACK-BACKED GULL/*Larus marinus* Linnaeus
Site Records - D38-A.

7.22.6 TERNS
Site Records - (Figure 7.22.5) - D9-P, D37-P, D47-C.

7.22.7 GREAT BLUE HERON/*Ardea herodias* Linnaeus
Site Records - D16-P.

7.22.8 PHALAROPES
Site Records - D17-P.

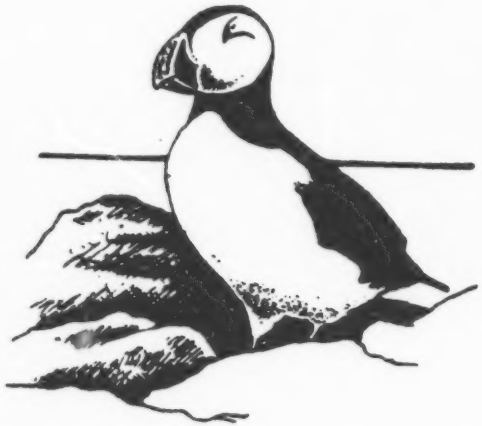
7.22.9 - (Figure 7.22.6) - SANDPIPERS (Unidentified species)
Site Records - D20-C, S5-C, S7-A, S9-A, S14-C, S15-A, S16-C, S20-C.

7.22.10 RAZOR-BILL/*Alca torda* Linnaeus
Site Records - D29-P.

7.22.11 MURRES
Site Records - D37-C.

7.22.12 PUFFIN/*Fratercula arctica* (Linnaeus)
Site Records - D38-P.

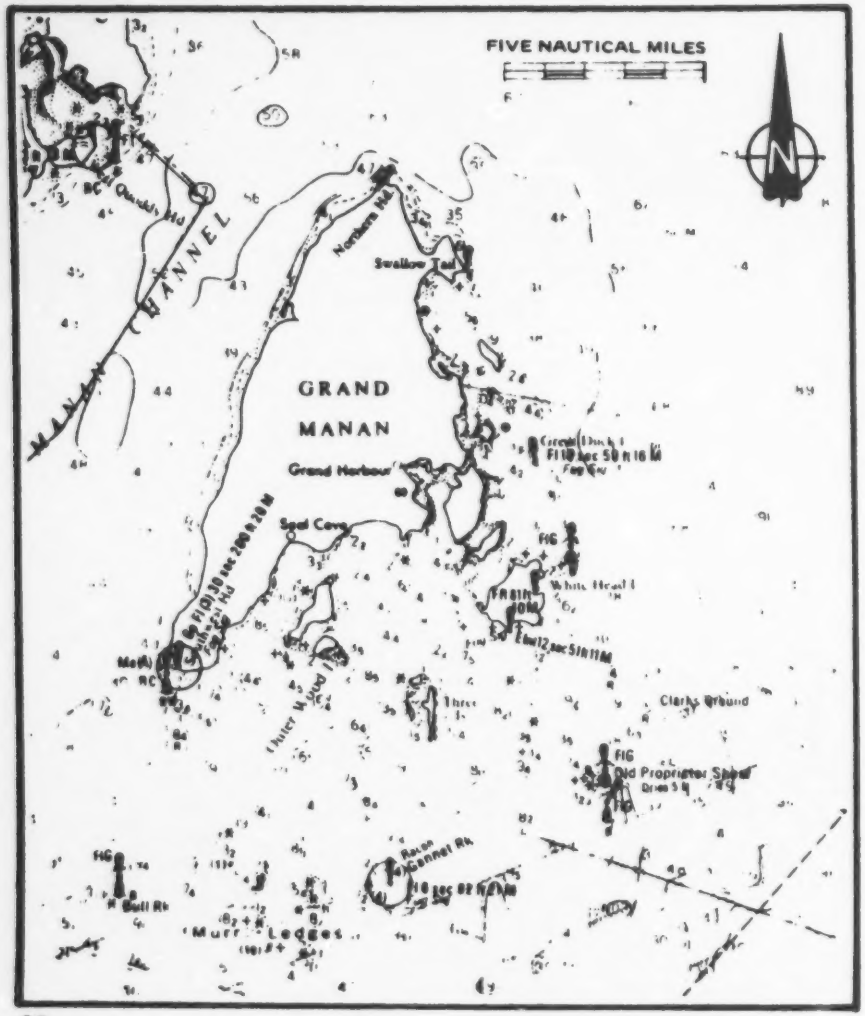
7.22.13 OSPREY/*Pandion haliatus* (Linnaeus)
Site Records - S6-P.



PUFFIN

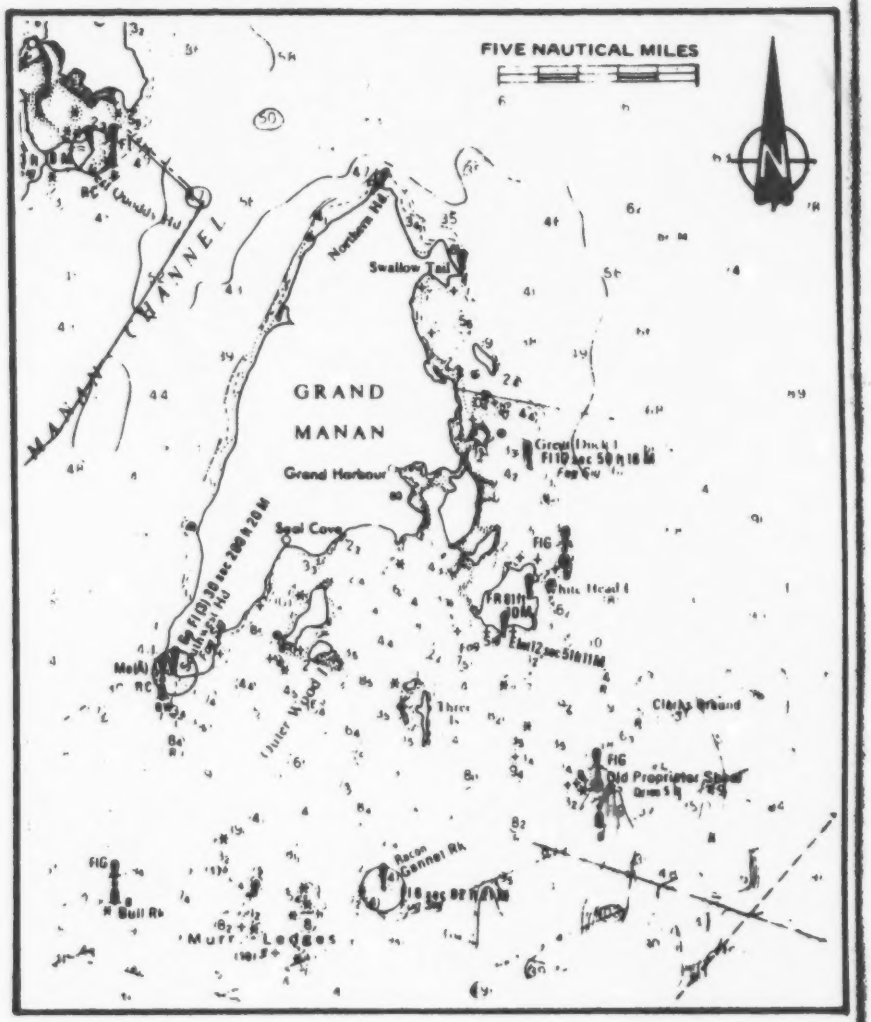
7.22.1
SITE RECORDS
DOUBLE-CRESTED CORMORANT

THE GRAND MANAN ARCHIPELAGO



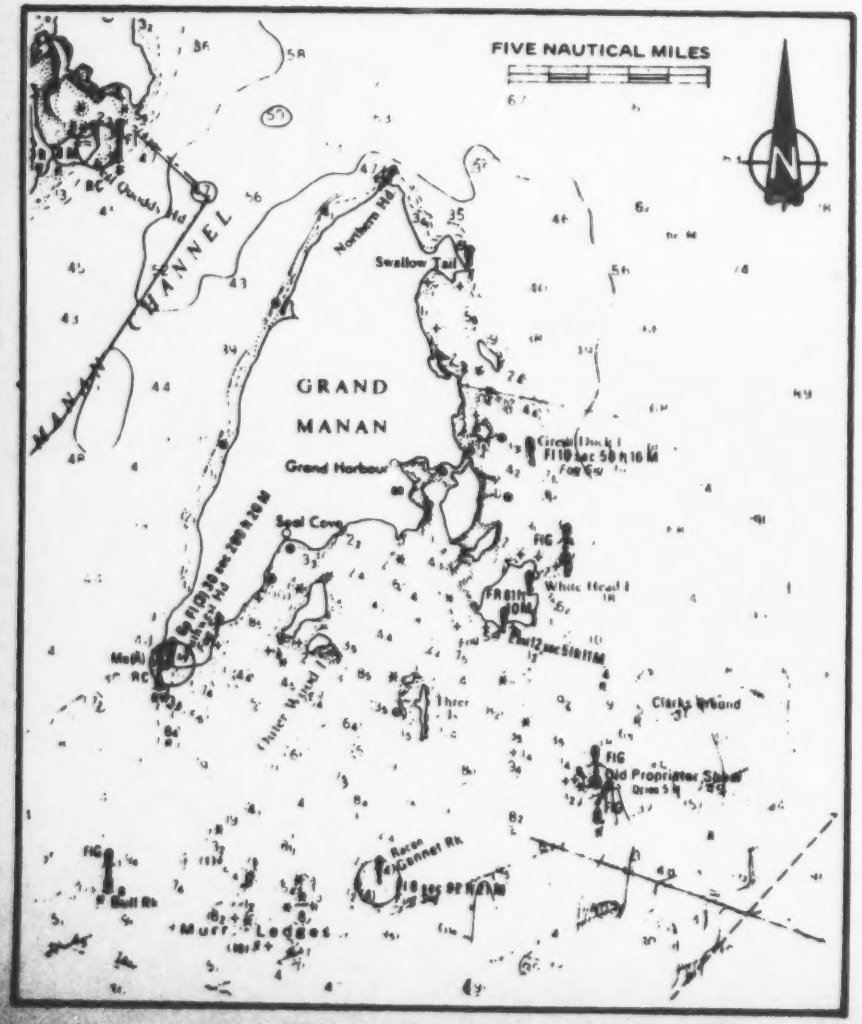
7.22.2
SITE RECORDS
THE BLACK GUILLEMOT

THE GRAND MANAN ARCHIPELAGO



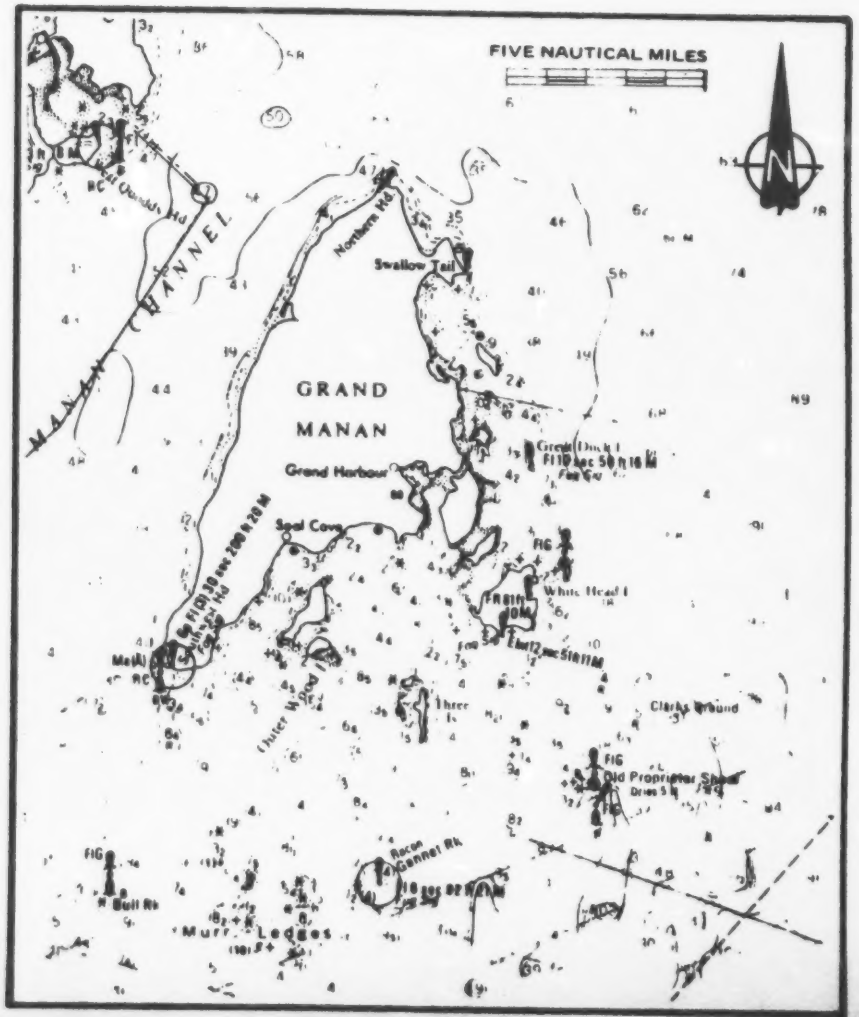
7.22.3
SITE RECORDS
THE COMMON EIDER

THE GRAND MANAN ARCHIPELAGO



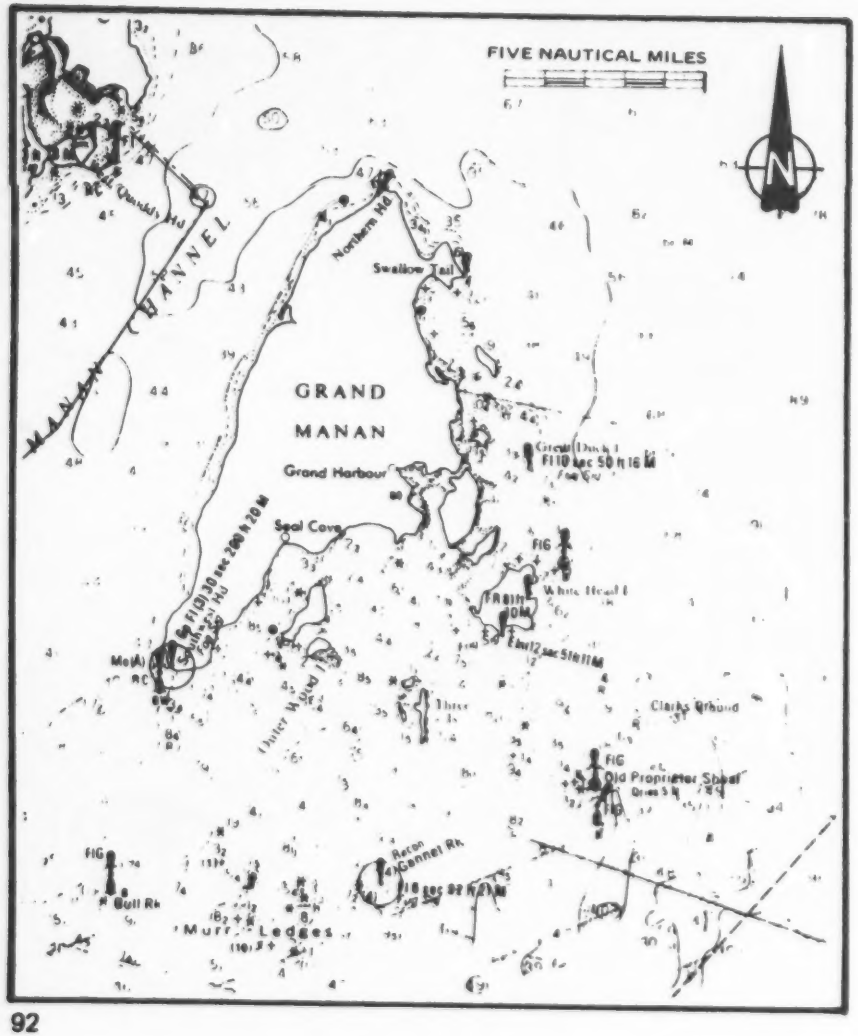
7.22.4
SITE RECORDS
THE HERRING GULL

THE GRAND MANAN ARCHIPELAGO



7.22.5
SITE RECORDS
TERNS

THE GRAND MANAN ARCHIPELAGO



7.22.6
SITE RECORDS
SANDPIPERS (Unidentified species)

THE GRAND MANAN ARCHIPELAGO

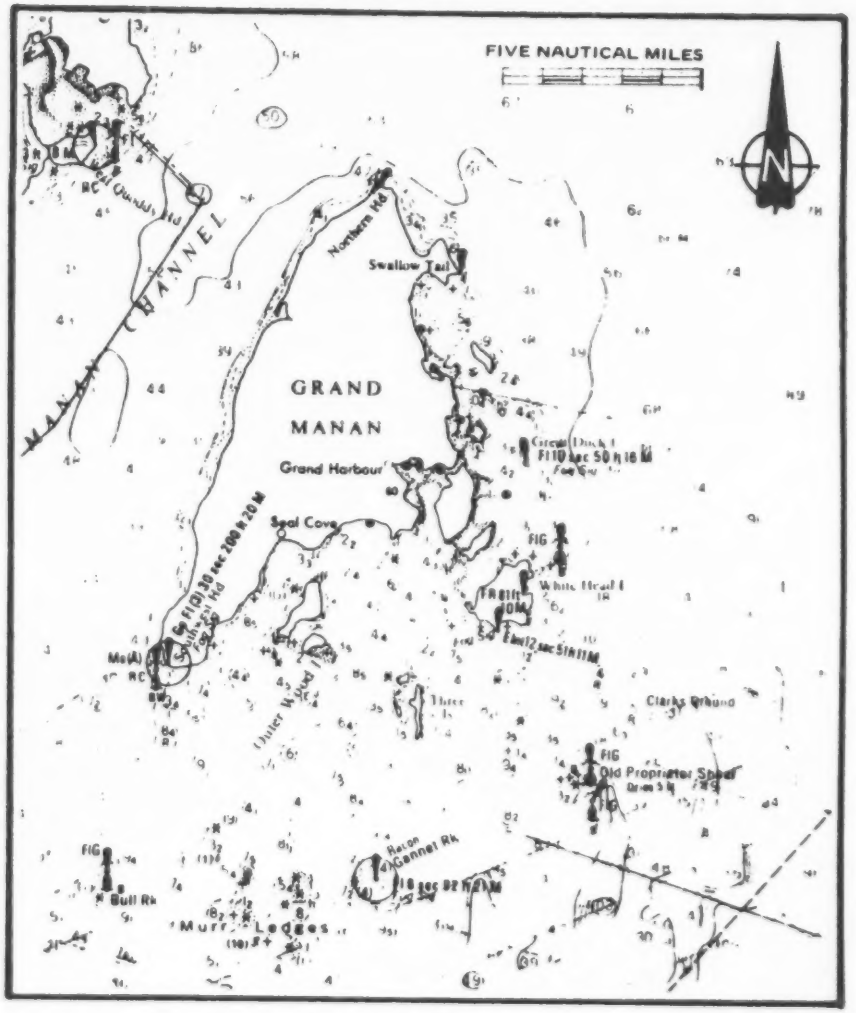


TABLE 7.21.7 MARINE BIRDS RECORDED IN THE STUDY AREA AND VICINITY

Gavia immer immer (Common Loon)
Gavia stellata (Red-throated Loon)
Podiceps grisegena holboelli (Red-necked Grebe)
Podiceps auritus (Horned Grebe)
Podilymbus podiceps podiceps (Pied-billed Grebe)
Diomedea chlororhynchos (Yellow-nosed Albatross)
Puffinus griseus (Sotty Shearwater)
Puffinus gravis (Greater Shearwater)
Fulmarus glacialis (Northern Fulmar)
Oceanodroma leucorhoa (Leach's Petrel)
Oceanites oceanicus (Wilson Petrel)
Morus bassanus (Northern Gannet)
Phalacrocorax carbo carbo (European Cormorant)
Phalacrocorax auritus auritus (Double-crested Cormorant)
Ardea herodias herodias (Great Blue Heron)
Butorides striatus virescens (Green Heron)
Nycticorax nycticorax hoacth (Black-crowned Night Heron)
Botaurus lentiginosus (American Bittern)
Ixobrychus exilis (Least Bittern)
Branta canadensis canadensis (Canada Goose)
Branta bernicla hrota (American Brant)
Anas platyrhynchos (Mallard)
Anas rubripes (Black Duck)
Anas acuta tzitzihoa (Common Pintail)
Anas crecca (Green-winged Teal)
Anas discors (Blue-winged Teal)
Aythya marila (Greater Scaup)
Bucephala clangula americana (Common Golden-eye)
Bucephala albeola (Bufflehead)
Clangula hyemalis (Old-squaw)
Somateria mollissima dresseri (Common Eider)
Melanitta deglandi (White-winged Scoter)
Melanitta perspicillata (Surf Scoter)
Melanitta nigra (Black Scoter)
Mergus serrator (Red-breasted Merganser)

Porzana caolina (Sora)
Charadrius melodus (Piping Plover)
Charadrius semipalmatus (Semipalmated Plover)
Charadrius vociferus vociferus (Killdeer)
Pluvialis dominica dominica (American Golden Plover)
Pluvialis squalarola (Black-bellied Plover)
Arenaria interpres morinella (Ruddy Turnstone)
Actitis macularia (Spotted Sandpiper)
Tringa melanoleucas (Greater Yellow-legs)
Tringa flavipes (Lesser Yellow-legs)
Calidris Maritima (Purple Sandpiper)
Calidris Melanotos (Pectoral Sandpiper)
Calidris fuscicollis (White-rumped Sandpiper)
Calidris minutilla (Least Sandpiper)
Calidris alpina sakhalina (Dunlin)
Limnodromus griseus (Short-billed Dowitcher)
Calidris pusilla (Semipalmated Sandpiper)
Calidris alba (Sanderling)
Phalaropus fulicarirus (Red Phalarope)
Phalaropus lobatus (Northern Phalaropes)
Stercorarius parasiticus (Parasitic Jaegar)
Larus hyperboreus (Glaucous Gull)
Larus glaucoides (Iceland Gull)
Larus marinus (Great Balck-backed Gull)
Larus argentatus smithsonianus (Herring Gull)
Larus philadelphia (Bonaparte's Gull)
Rissa tridactyla tridactyla (Black-legged Kittiwake)
Sterna hirundo hirundo (Common Tern)
Sterna paradisaea (Arctic Tern)
Alca torda (Razorbill)
Uria aalge aalge (Common Murre)
Uria lomvia lomvia (Thick-billed Murre)
Alle alle (Dovekie)
Cepphus grylle grylle (Black Guillemot)
Fratercula arctica arctica (Atlantic Puffin)

MAMMALS
(SEALS, PORPOISE, WHALES)

HARBOUR SEAL

HARBOUR PORPOISE

7.23 INTRODUCTION

As shown in Table 7.23.1 numerous marine mammals occur in the study area. Site records during this study were as follows:

HARBOUR SEAL - D12-P, D16-P, D17-P, D29-P, D37-P, S23-P.

FINBACK (?) WHALE - D39-P.

GRAY SEAL (?) - D42-P.

TABLE 7.23.1 MARINE MAMMALS OF THE STUDY AREA

A. BALEEN WHALES		
Eubalaena glacialis	right whale	Sporadic visitor. Endangered species.
Megaptera novaeangliae	humpback whale	Regular visitor to Brier Island. Endangered species.
Balaenoptera physalus	finback whale	Regular visitor
Balaenoptera borealis	sei whale	Regular visitor to southern part of Brier Island.
Balaenoptera acutorostrata	minke whale	Regular visitor
Balaenoptera musculus	blue whale	Reported sporadically but not in last 15 years. Endangered species.
B. TOOTHED WHALES		
Phocoena phocoena	harbour porpoise	Regular resident for up to 12 months of year, but most of the population migrates offshore in fall.
Lagenorhynchus acutus	white-sided dolphin	Sporadic visitor.
Lagenorhynchus albirostris	white-beaked dolphin	Regular visitor; may be residential in outer region.
Globicephala melaena	pothead whale	Sporadic visitor, but forms large schools.
Delphinapterus leucas	white whale	Occasional strays from Gulf of St. Lawrence (one in 1976).
Ziphius cavirostris	Cuvier's beaked whale	Probably sporadic visitor.
Kogia breviceps	Pigmy sperm whale	Probable sporadic visitor.
Tursiops truncatus	Bottlenosed dolphin	Possible rare visitor.
Delphinus delphis	Common dolphin	Possible rare visitor.
Orcinus orca	Killer whale	Sporadic visitor.
C. PHOCID SEALS		
Halichoerus grypus	Grey seal	Local resident - Grand Manan only.
Phoca vitulina	Harbour seal	Previously common, much reduced by bounty hunting, now recovering.

PLANTS
(SEAWEEDS, ETC.)

7.25 INTRODUCTION

Numerous species of marine plants occur intertidally and subtidally in the Bay of Fundy. They are most abundant and diverse in the intertidal area and in shallow subtidal waters. The majority of species occur on hard substrate but some species (Enteromorpha, Ulva) occur on mudflats. In the study area marine plants are a common component of intertidal and subtidal zones.

Potential exists for commercial utilization of a variety of marine algae (rockweed, kelp, etc.), harvesting and marketing has yet to be developed.

7.26 ANNOTATED LIST OF SPECIES

7.26.1 IRISH MOSS/*Chondrus crispus* (Stackhouse)

Description - Profusely branched clumps usually less than 3 inches high; dark red, almost black with blue iridescence showing on branches.

Habitat - Common near the low water mark on rocks or ledge, often mixed with dulse.

Commercial utilization - Harvested elsewhere for use in food products and other commercial materials. Irish moss does not occur in large enough quantities in the study area for commercial operations.

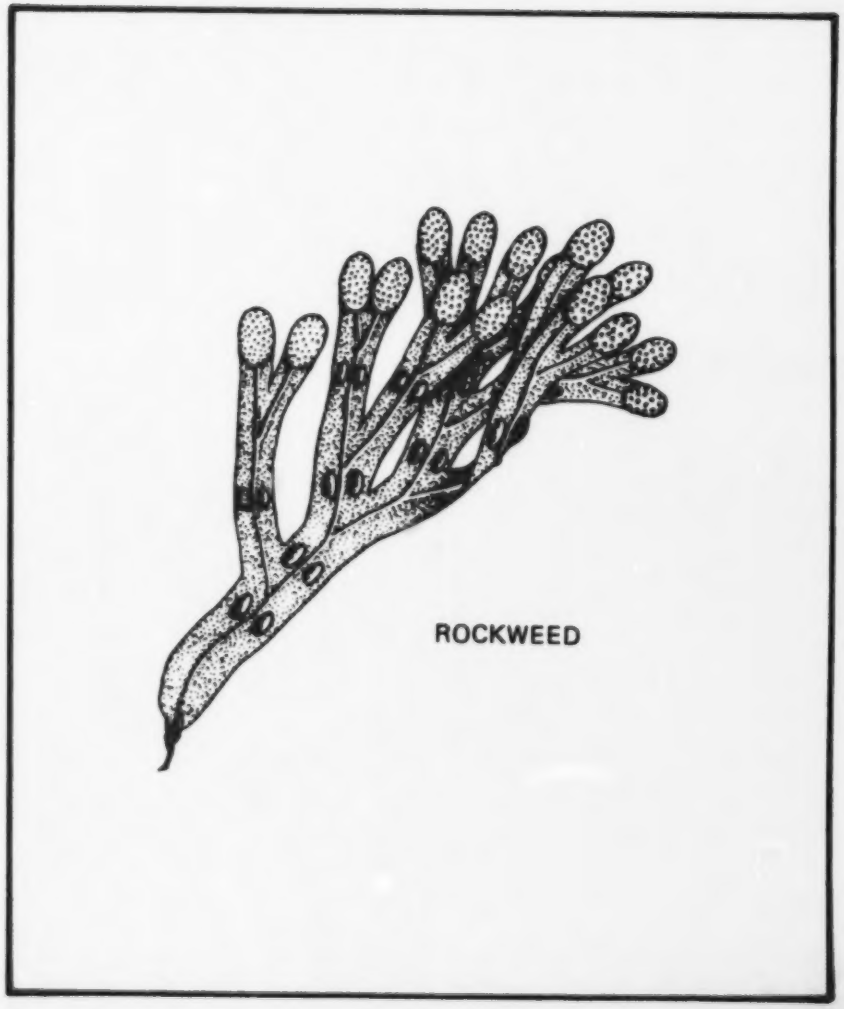
Distribution and Abundance - (Figure 7.26.1) - T9-P, D3-P, D14-A, D22-C-P, D25-C, D28-A, D29-P, D30-C, D31-P, D32-A, D39-C, D40-C, D42-C, S1-C, S2-P, S3-P, S4-P, S5-P, S6-P, S8-P, S9-P-C-A, S10-P, S11-P-C, S13-P, S18-P, S20-C, S22-P-C, S24-C,-A, S26-P-C.

7.26.2 CORAL ALGA/*Lithothamnion sp.* (Aresch)

Description - Encrusting, calcareous; occasionally free clumps to 5 inches in diameter; light pink.

Habitat - Occasionally on rocks and shells in tide pools. Abundant from low water to 60 feet on ledge, rocks and shells.

Distribution and Abundance - (Figure 7.26.2) - T1-P-C, T2-P-C, T4-A, T5-P-C-A, T6-A, T8-A, T9-A, D3-C-A, D5-A, D6-A, D7-A , D10-A, D11-C, D13-A, D14-A, D15-A, D16-A, D17-A, D18-P, D19-P, D20-A, D21-A, D22-P, D23-A, D25-A, D26-A, D27-P, D28-P, D29-C, D31-P, D32-P, D33-P, D36-A, D39-P-C, D40-C, D42-C, D44-C, D45-C, D47-C, D46-C, S1-C, S3-P, S6-P, S9-P, S10-P, S15-C, S20-P, S23-P.



ROCKWEED

7.26.3 DULSE/*Rhodymenia palmata* (Greville)

Description - Flat, branching fronds growing from a holdfast; fronds to 18 inches depending on habitat; varying shades of dark red.

Habitat - On rocks, occasionally in tide pools; most common around low water mark and subtidally to 5 feet on rocks and ledge.

Commercial Utilization - Harvested by hand, dried and cleaned, this species is marketed as a food product. It is also ground and sold for use in the food industry.

Distribution and Abundance - (Figure 7.26.3) - T1-C, T2-P-C, T4-C, T5-P-C, T6-P, T7-P, T8-A, T9-P-A, D3-C, D5-P, D13-C, D14-C, D15-P, D16-P, D20-P, D21-P, D22-P, D28-P, D29-C, D30-P, D32-P, D33-A, D34-P-C, D35-P, D36-C, D39-P, D40-C-A, D42-C, D43-P, D45-P, D46-P, D47-C, S1-P, S2-P, S3-C, S5-P, S9-P, S10-P, S11-P-C, S13-P, S16-P, S18-P, S20-C, S23-P-C, S24-P, S26-C.

7.26.4 RED ALGA/*Phycodrys rubens* (Batters)

Description - Thin-veined fronds growing from a holdfast; to 5 inches; dark red.

Habitat - Occurs subtidally to thirty feet on rocky substrate.

Distribution and Abundance - (Figure 7.26.4)- T1-P-A, T2-C, D19-P, D21-P, D29-P, D30-P-C, D31-A, D38-C-A, D39-A, D40-C, D41-P, D42-C, D43-C, D44-C, D46-P.

7.26.5 RED ALGA/*Polysiphonia lanosa* (Tandy)

Description - Small, multi-branched; to 2 inches; dark reddish-brown.

Habitat - Intertidal, growing on rockweed (*Ascophyllum* only)

Distribution and Abundance - (Figure 7.26.5) - T4-A, T5-P, T8-A, T9-P, D2-A, D3-P, D21-P, S2-C, S3-C, S4-P-C, S5-P, S6-P, S8-C, S9-C, S10-P-C, S13-C, S14-P, S15-C, S17-P, S18-P-C, S19-C, S20-A, S24-A, S26-P-C.

7.26.6 CORALLINE ALGA/*Corallina officinalis*

Description - A small branching pink alga with small hard calcareous sections.

Habitat - Occurs intertidally and subtidally, usually on rock.

Distribution and Abundance - (Figure 7.26.6) - T1-C-A, T2-C, T8-P, D22-C, D28-P, D29-C, D30-C-A, D39-A, D40-A, D42-C, D43-P, D44-C, D47-P, S1-P, S3-P, S23-P.

7.26.7 UNIDENTIFIED RED ALGAE - Unidentified species of red algae were recorded at a number of study sites.

Distribution and Abundance - (Figure 7.26.7) - T4-C, T5-P, T6-P, T8-C, D13-A, D32-C, D33-P-C, D36-A, D39-A.

7.26.8 NORI/*Porphyra sp.*

Description - Filmy sheets to 12 inches; red-brown; transluscent.

Habitat - Occurs intertidally on rocks, weir posts, wharves and subtidally on rocks.

Commercial Utilization - Potential exists for development of this alga for exportation to Japan.

Distribution and Abundance - (Figure 7.26.8) - T5-P-C, D25-C, D38-C, S1-C-A, D2-P, D3-P, D8-P, D11-P, D13-P, D16-P, D20-C, D24-P-C, D26-P-C.

7.26.9 KELP, DEVIL'S APRON/*Laminaria sp.*

Description - Long, flat, heavy frond from heavy stem and holdfast; to 10 feet; golden brown-dark brown. Species recorded for this area include: *L. longicruris, L. saccharina* and *L. digitata.*

Habitat - Occurs from low water to 10 feet on rocks.

Commercial Utilization - Used in food and chemical production (Kombu and Alginates)

Distribution and Abundance - (Figure 7.26.9) - T1-P-A, T2-P-A, T3-C, T4-C, T5-A, T6-P, T7-P, T8-A, T9-P-A, D1-A, D3-A, D13-A, D14-C, D21-P, D22-P, D23-A, D24-A, D27-A, D28-A, D29-A, D30-P-A, D31-P, D32-A, D33-A, D34-P, D35-C, D36-A, D38-P-C, D39-C, D40-C-A, D42-C, D43-A, D44-C, D45-C, D46-P, S1-P, S6-P, S8-C, S13-C, S20-C, S22-P, S23-P.

7.26.10 SEA COLLANDER/*Agarum cribrosum* (Bory)

Description - Kelp-like frond perforated with circular holes; distinct heavy midrib and holdfast; to 2 feet; golden, dark brown.

Habitat - Occurs occasionally in tide pools on rock. Most common subtidally to 40 feet on rocks and ledge.

Distribution and Abundance - (Figure 7.26.10) - T1-A, T2-C, T3-P, T4-P, T9-A, D3-A, D5-A, D6-A, D7-C, D10-A, D11-A, D12-A, D13-A, D14-

A, D15-P-C, D16-A, D17-A, D18-P-C, D19-P, D20-A, D21-P, D22-P, D23-A, D24-C, D26-A, D27-A, D29-P-A, D30-P-C, D31-A, D35-P, D36-A, D38-A, D39-A, D40-P-C, D41-C, D42-C, D43-P, D44-A, D45-C, D46-P, D47-P-C, S1-P.

7.26.11 WINGED KELP/*Alaria esculenta*

Description - Oval midrib; thin transluscent main blade; smaller blades below large blade; branched holdfast; to 5 feet; golden, dark brown.

Habitat - Occurs occasionally in tide pools on rock; most common subtidally from low water to 5 feet on rocks.

Commercial Utilization - Although edible no market exists at present (Neish, 1973).

Distribution and Abundance - (Figure 7.26.11) - T1-P-A, T2-C-A, T3-P-C, T4-P-C-A, T5-P, T6-A, T7-A, T8-A, T9-A, D1-A, D3-A, D5-A, D13-A, D14-A, D17-A, D21-C, D22-C, D25-C, D27-P, D28-A, D29-P-C, D30-P-A, D31-C, D32-A, D33-P, D36-A, D38-A, D39-A, D40-C, D42-P, D43-A, D44-P, D45-C, D46-P, D47-P, S1-P, S6-P, S20-A, S22-P, S23-P.

7.26.12 ROCKWEED/*Ascophyllum nodosum* (Le Jolis)

Description - Multi-branching narrow fronds with many air bladders; to 4 feet; light to dark green.

Habitat - Most common intertidal algae. Occurs on rocks; does not grow subtidally.

Commercial Utilization - Although used to produce rockweed meal, no harvesting currently takes place due to lack of market.

Distribution and Abundance - (Figure 7.26.12) - T4-A, T5-P, T6-A, T7-P, T8-A, T9-P, D3-P, D13-A, D39-A, S2-A, S3-A, S4-C-A, S5-P-A, S6-P-A, S8-A, S9-P-C, S11-P-C, S12-C, S13-A, S14-P, S15-P-A, S16-P, S17-P-A, S18-P-C, S19-P-C, S20-A, S23-C-A, S23-A, S26-P-A.

7.26.13 ROCKWEED/*Fucus vesiculosus* (Linnaeus)
F. spiralis (Linnaeus)
F. edentatus (De La Pylaie)

Description - *F. vesiculosus* - Flat, multi-branching fronds with air bladders; to 18 inches; solid single holdfast; yellow, green-brown

F. spiralis - Flat fronds; no air bladders; to 6 inches; solid single holdfast; yellow-brown.

F. edentatus - Flat fronds; no air bladders; to 18 inches; solid single holdfast; dark olive green-brown.

Habitat - *F. vesiculosus* - The most common species, it occurs intertidally from a few feet from high water to within a few feet of low water.

F. spiralis - This species occurs in a narrow band a few feet from high water.

F. edentatus - This species occurs at and near low water on rocks.

Commercial Utilization - These species may be used in the production of rockweed meal. No harvesting presently takes place due to lack of market.

Distribution and Abundance - (Figure 7.26.13 to 7.26.15) -

Fucus edentatus

T5-C, T8-C, D21-P, D40-P, S1-P, S2-P-C, S3-A, S4-P-C, S5-P, S6-P, S8-P, S9-C, S11-P, S12-P, S20-C, S23-P-C, S24-C-A, S26-C.

Fucus spiralis

S16-C, S20-C.

Fucus vesiculosus

T4-A, T5-P, T9-C, D13-C, D14-A, D21-P, D39-P, S1-A, S2-C, S4-P-C, 5-P-C, S6-P-C, S8-C, S9-C-A, S10-P, S11-P, S12-P-C, S13-C, S14-P, S15-P-C, S16-C, S17-P-C, S18-P-C, S19-C, S20-P, S22-P-C, S22-P, S24-C, S25-P, S26-C.

7.26.14 OTHER BROWN ALGAE

Chordaria sp.

D3-P, D7-P, D38-C.

Desmerestia sp. - (Figure 7.26.15) - T1-C, T2-P, T3-C-A, D3-P, D7-A, D15-C, D21-P, D29-P-C, D35-A, D40-C, D41-C, D42-C, D43-C, D45-C, D46-C, S1-P, S11-P-C, S14-P, S21-P, S23-P, S25-C.

Chorda sp. -

S3-P, S21-P, S24-P.

7.26.15 SEA LETTUCE/*Ulva sp.*

Description - This species resembles a lettuce leaf; to 18 inches; translucent green.

Habitat - Occurs intertidally in tide pools, mud flats, and on rock to low water. Also occurs, in some areas, subtidally on rock, to about 5 feet.

Commercial Utilization - Can be used as a seasoning but at present there is no local market.

Distribution and Abundance - (Figure 7.26.17) - T1-C, T3-A, T4-C, T6-P, T9-P-C-A, D1-C, D3-A, D8-C, D14-C, D21-P, D22-A, D23-P, D25-C, D33-A, D34-P-C, D36-C, D38-C, D40-C, D45-C, S1-A, S2-P, S3-P, S4-C, S5-P, S6-P-C, S8-C-A, S9-C, S10-P, S12-P-C, S13-P, S14-P, S15-P-C, S16-P, S17-P, S18-P, S19-P-C, S20-C, S22-P-C, S23-P, S24-P-C, S26-P-A.

7.26.16 GREEN ALGA/*Enteromorpha sp.*

Description - Filamentous algae; to 3 feet in length; green, often colored by mud.

Habitat - Occurs intertidally on mudflats and rocks from mid littoral to low water.

Distribution and Abundance - (Figure 7.26.18) - T9-P, D11-C, D13-C, D15-P-C, D16-C, D19-P, D20-C-A, D23-P, D24-P, D26-P.

7.26.17 GREEN ALGA/*Spongomorpha sp.*

Description - Sponge-like; encrusting on rock; to 2 inches and more; green.

Habitat - This species occurs at or near low water on rock.

Distribution and Abundance - (Figure 7.26.19) - D42-C, S24-C.

7.26.18 EEL GRASS/*Zostera marina*

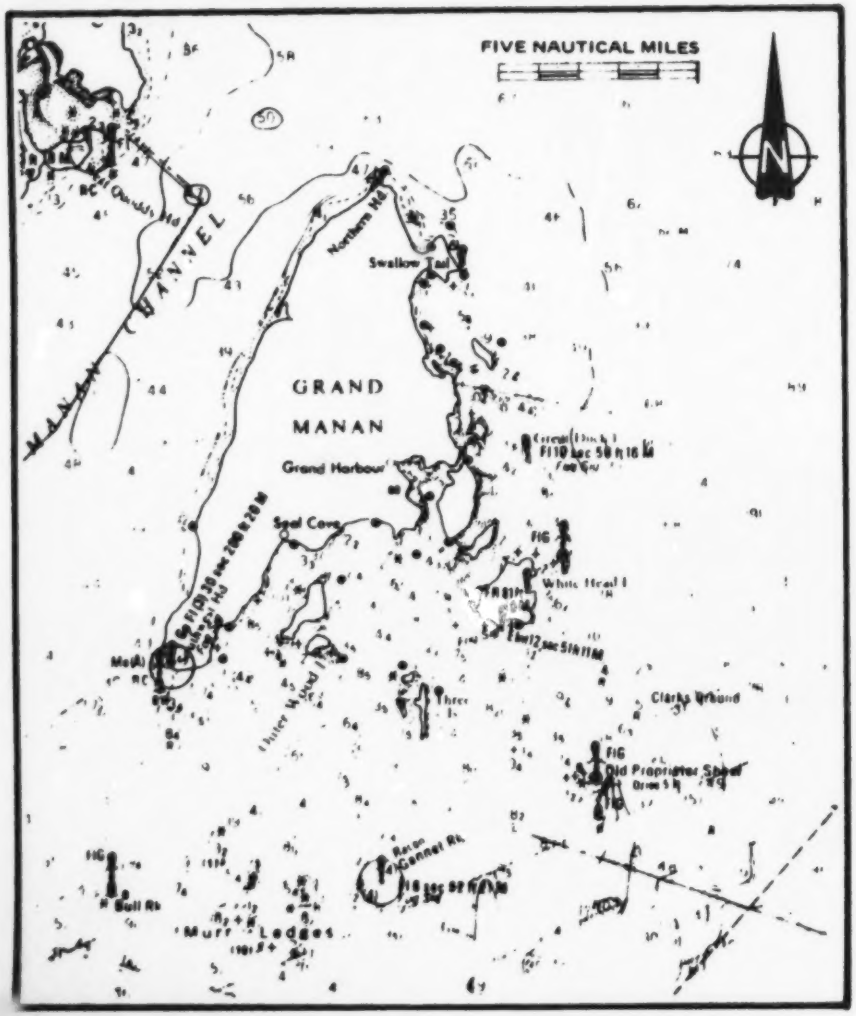
Description - A marine grass growing to 8 to 10 inches from a stolon-like root system.

Habitat - Usually found near the low water mark on sand bottom.

Distribution and Abundance - (Figure 7.26.20) - S9-A, S11-A, S14-P, S18-P, S13-A, S15-A.

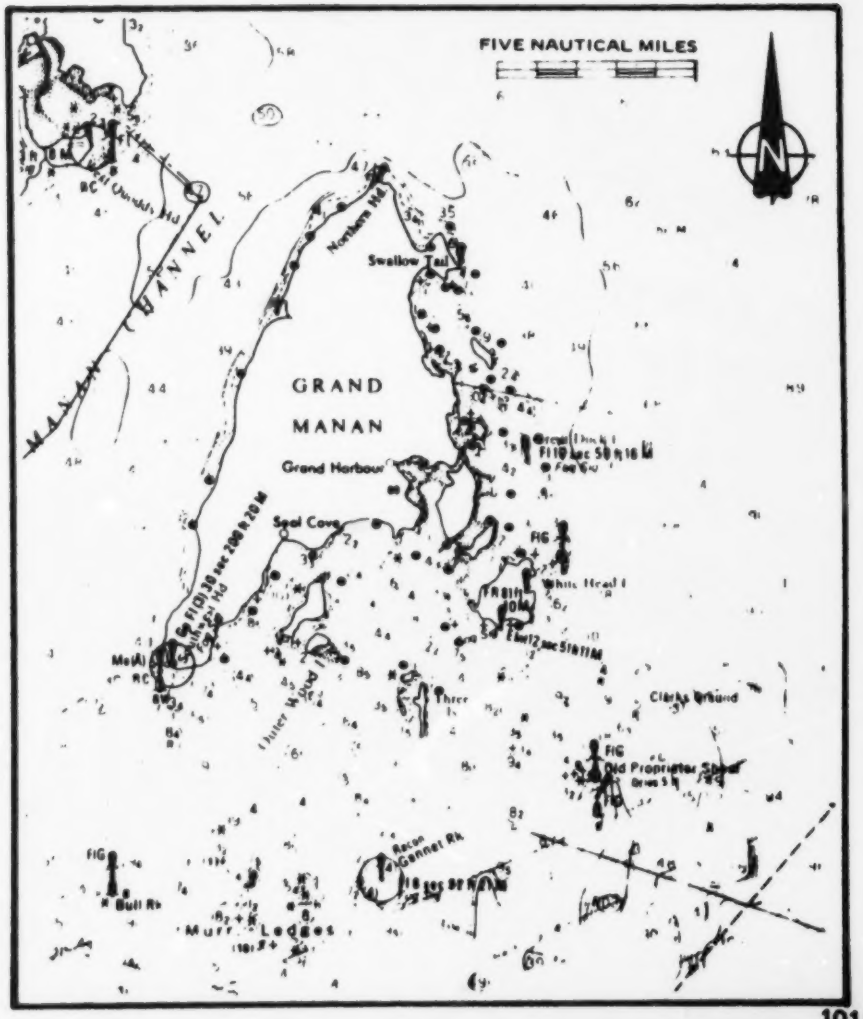
7.26.1
DISTRIBUTION OF IRISH MOSS

THE GRAND MANAN ARCHIPELAGO

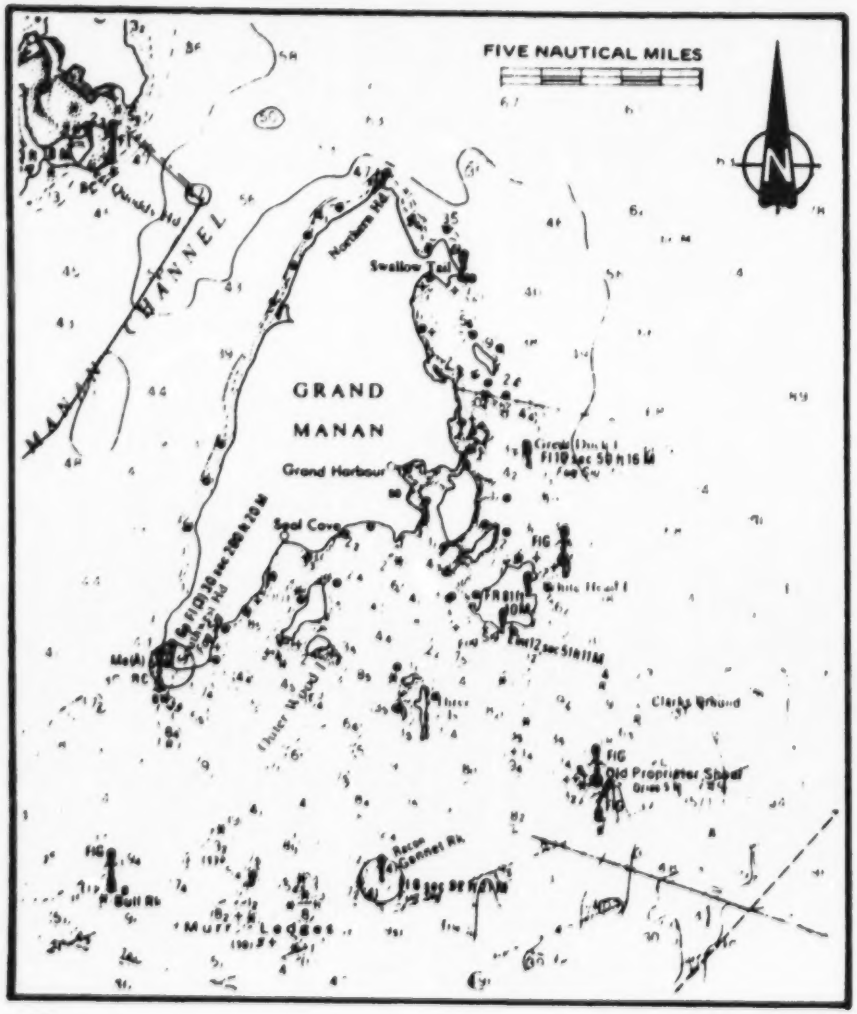


7.26.2
DISTRIBUTION OF CORAL ALGA (Lithothamnion)

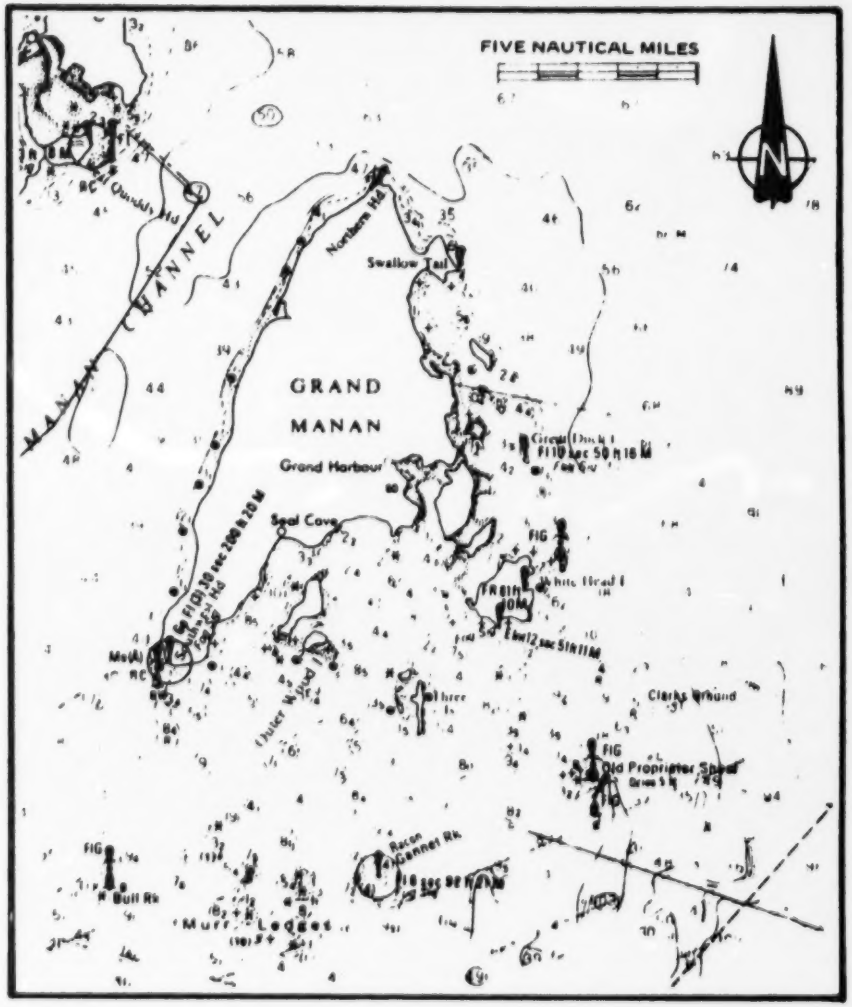
THE GRAND MANAN ARCHIPELAGO



7.26.3
DISTRIBUTION OF DULSE THE GRAND MANAN ARCHIPELAGO

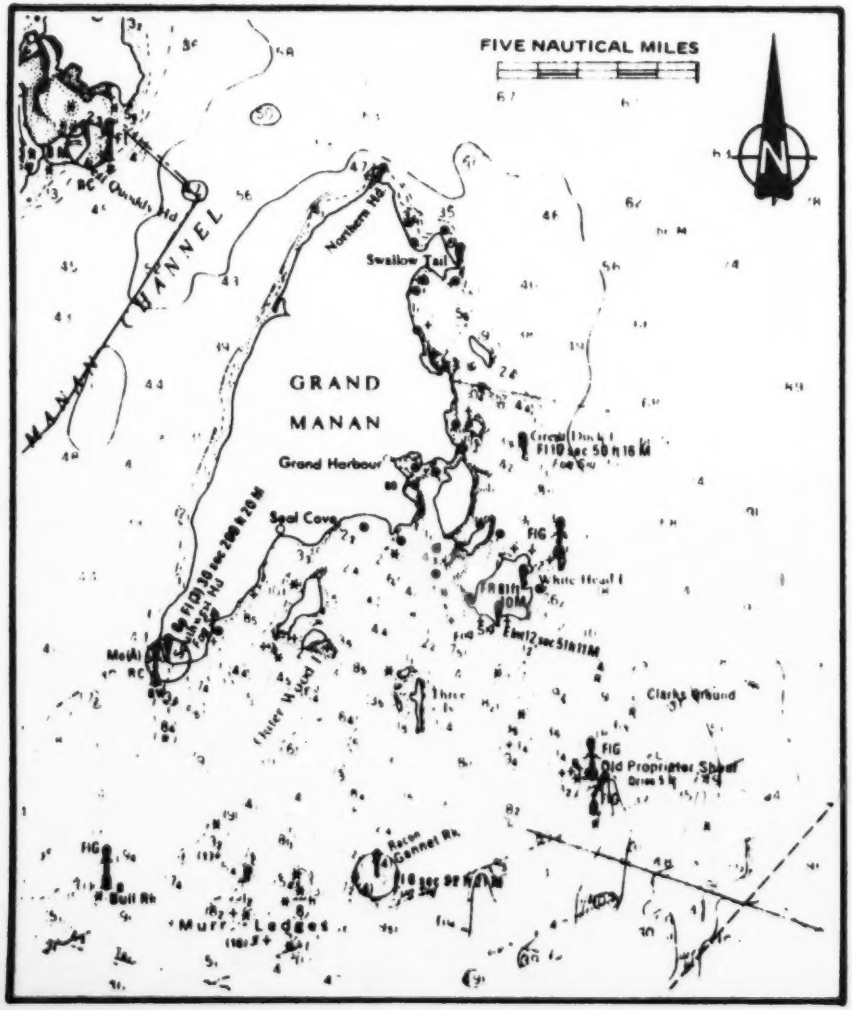


7.26.4
DISTRIBUTION OF THE ALGA PHYCODRYS THE GRAND MANAN ARCHIPELAGO



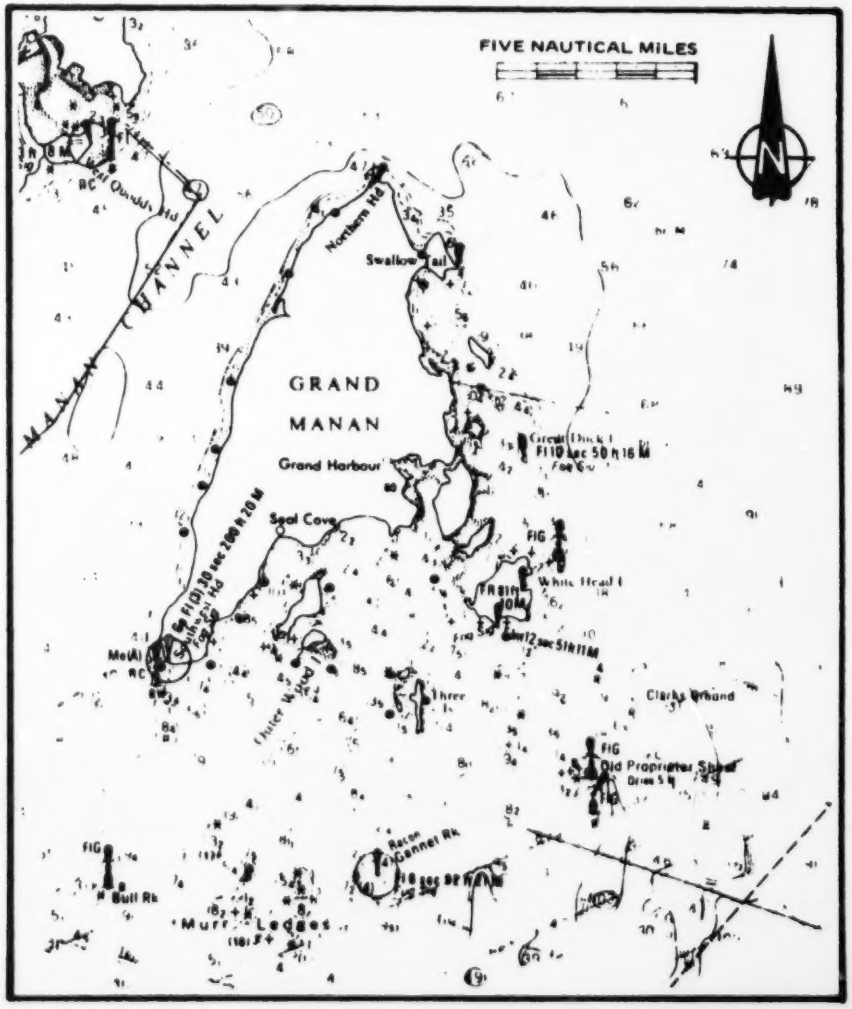
7.26.5
DISTRIBUTION OF THE ALGA
POLYSIPHONIA

THE GRAND MANAN ARCHIPELAGO

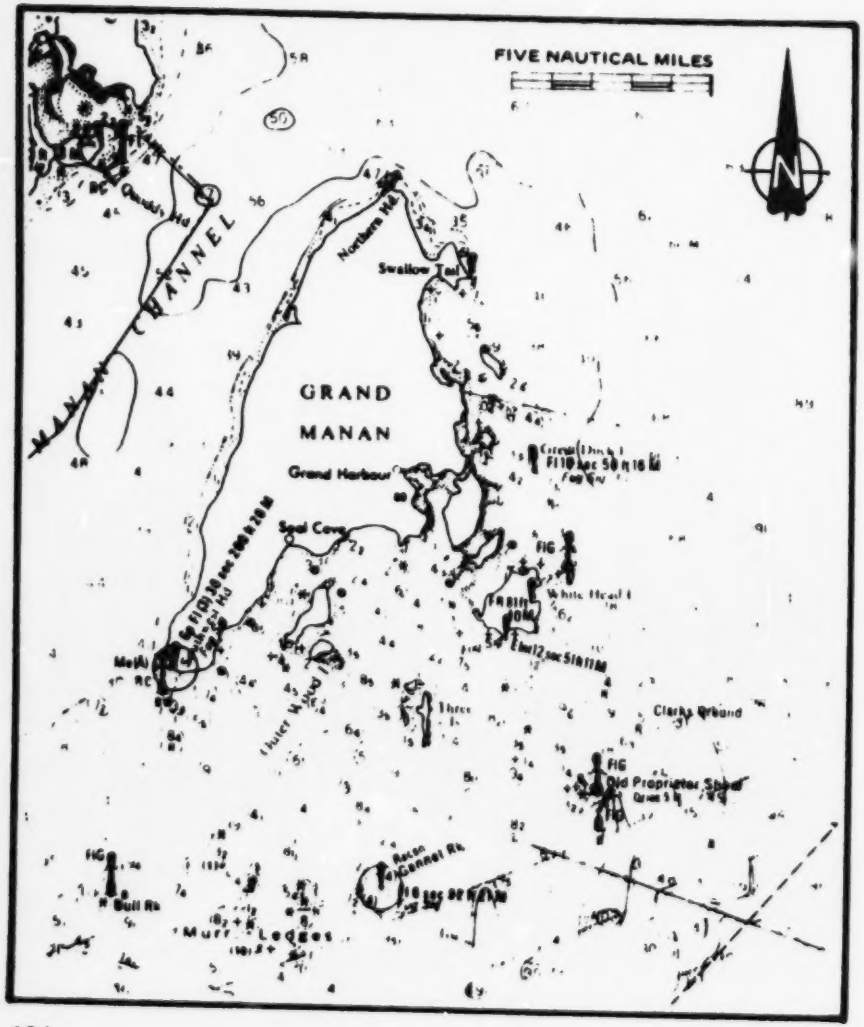


7.26.6
DISTRIBUTION OF
CORALLINE ALGA

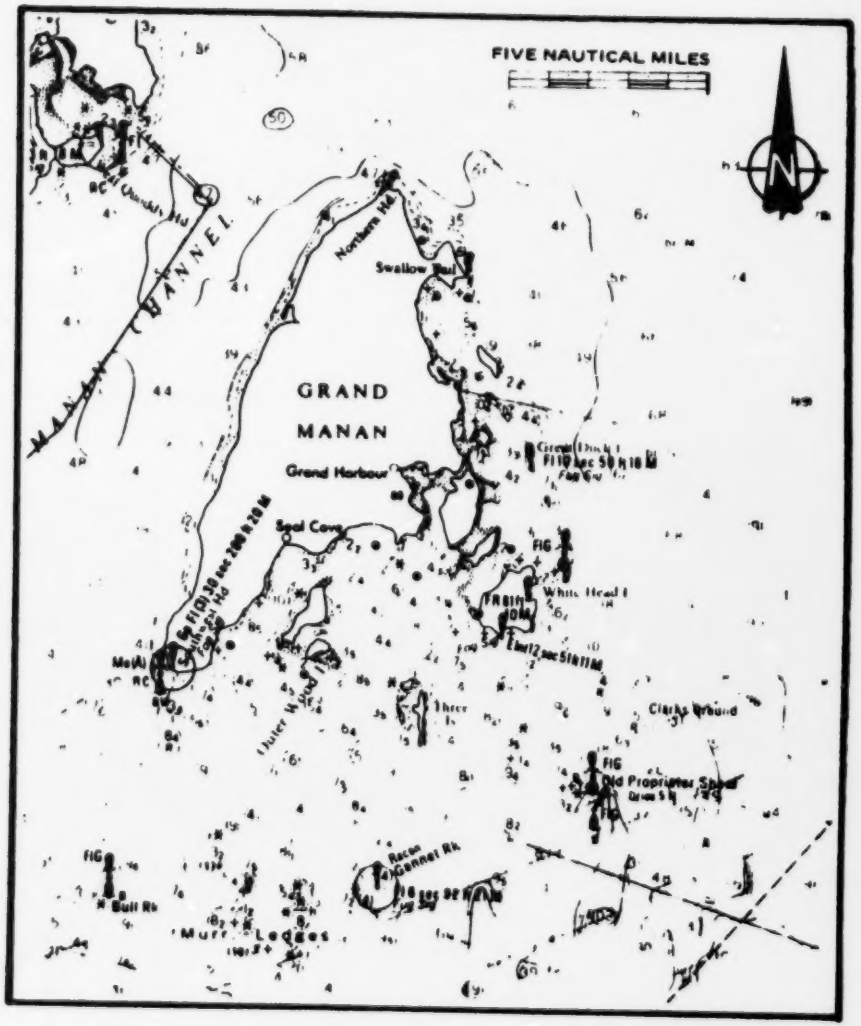
THE GRAND MANAN ARCHIPELAGO



7.26.7
DISTRIBUTION OF UNIDENTIFIED RED ALGAE
THE GRAND MANAN ARCHIPELAGO

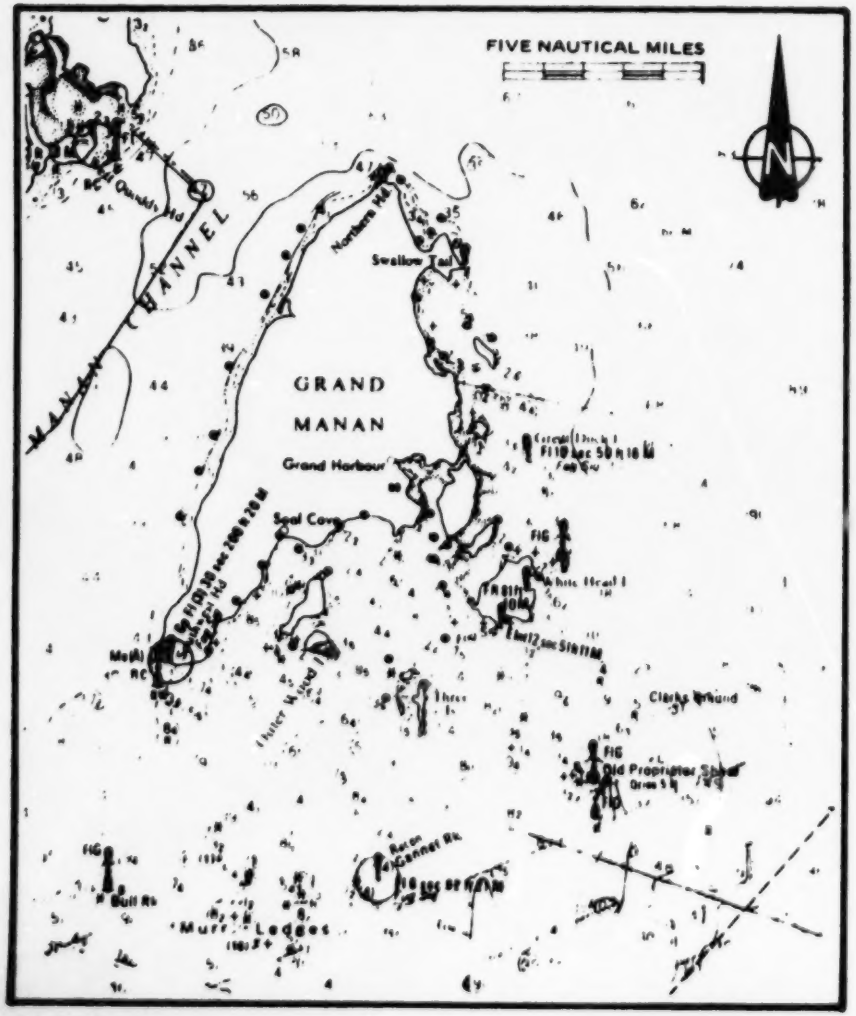


7.26.8
DISTRIBUTION OF THE ALGA PORPHYRA
THE GRAND MANAN ARCHIPELAGO



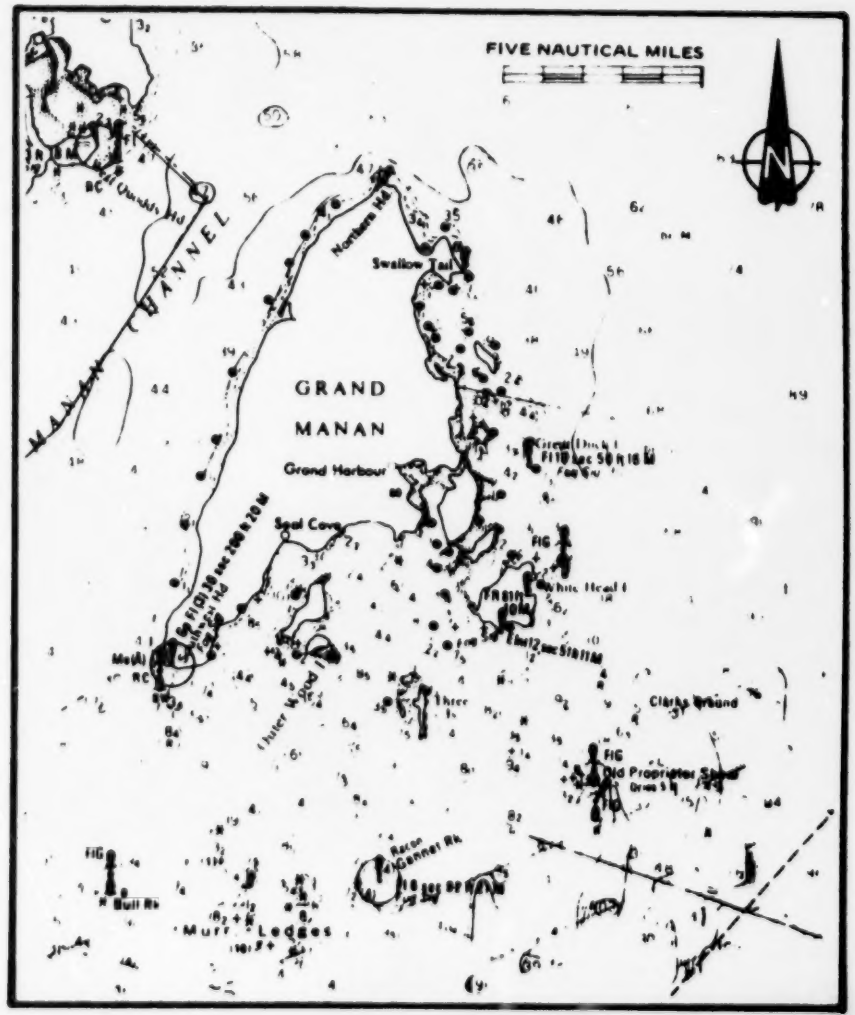
7.26.9
DISTRIBUTION OF KELP
(Laminaria)

THE GRAND MANAN ARCHIPELAGO



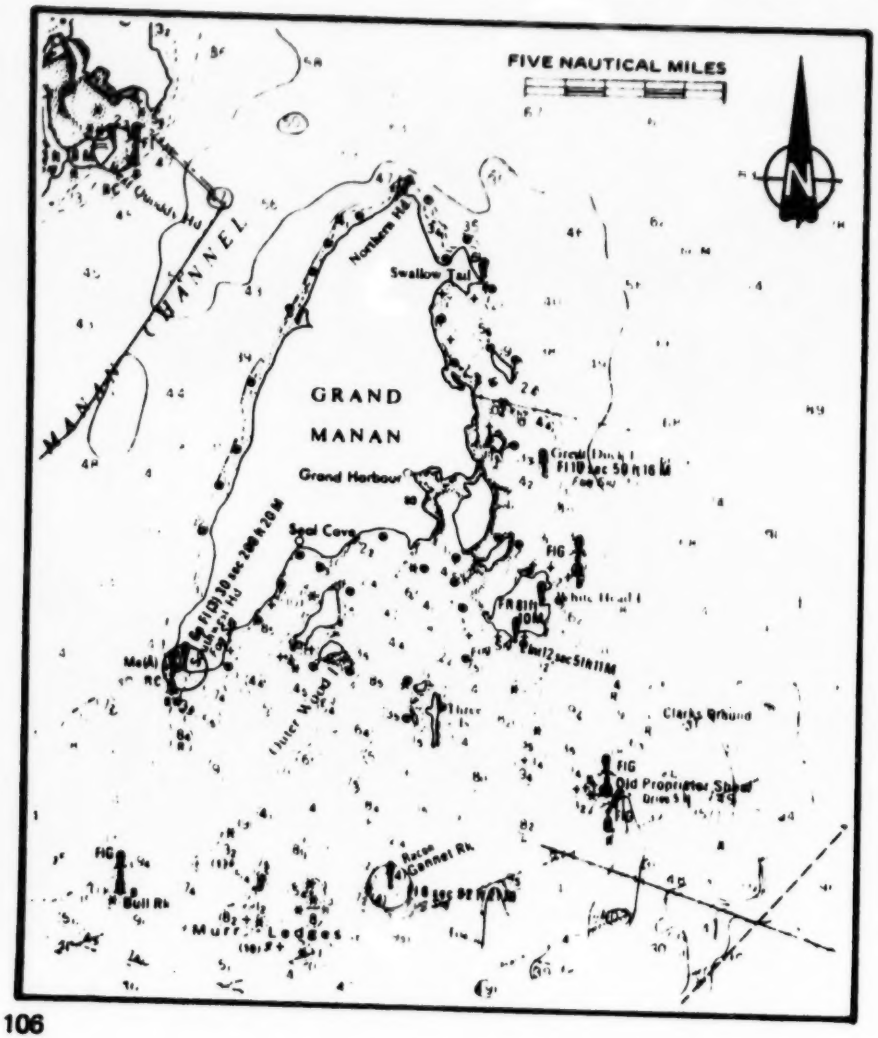
7.26.10
DISTRIBUTION OF
SEA COLLANDER

THE GRAND MANAN ARCHIPELAGO



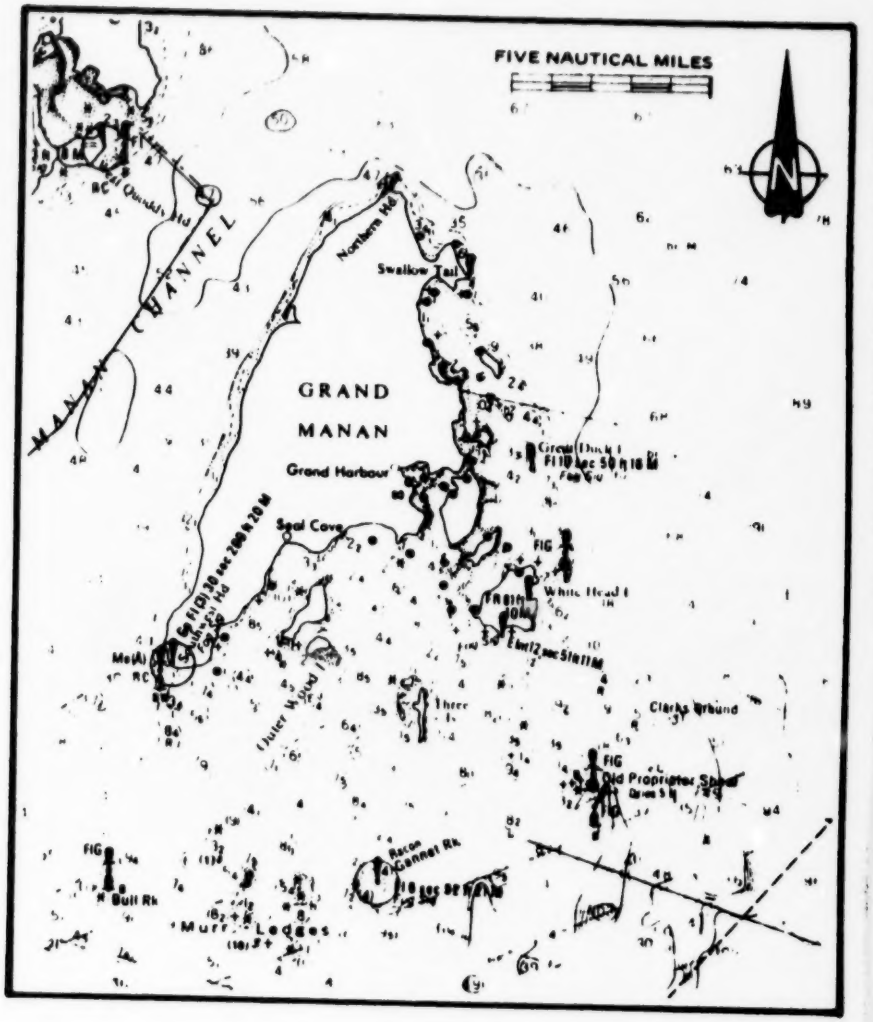
7.26.11
DISTRIBUTION WINGED KELP

THE GRAND MANAN ARCHIPELAGO



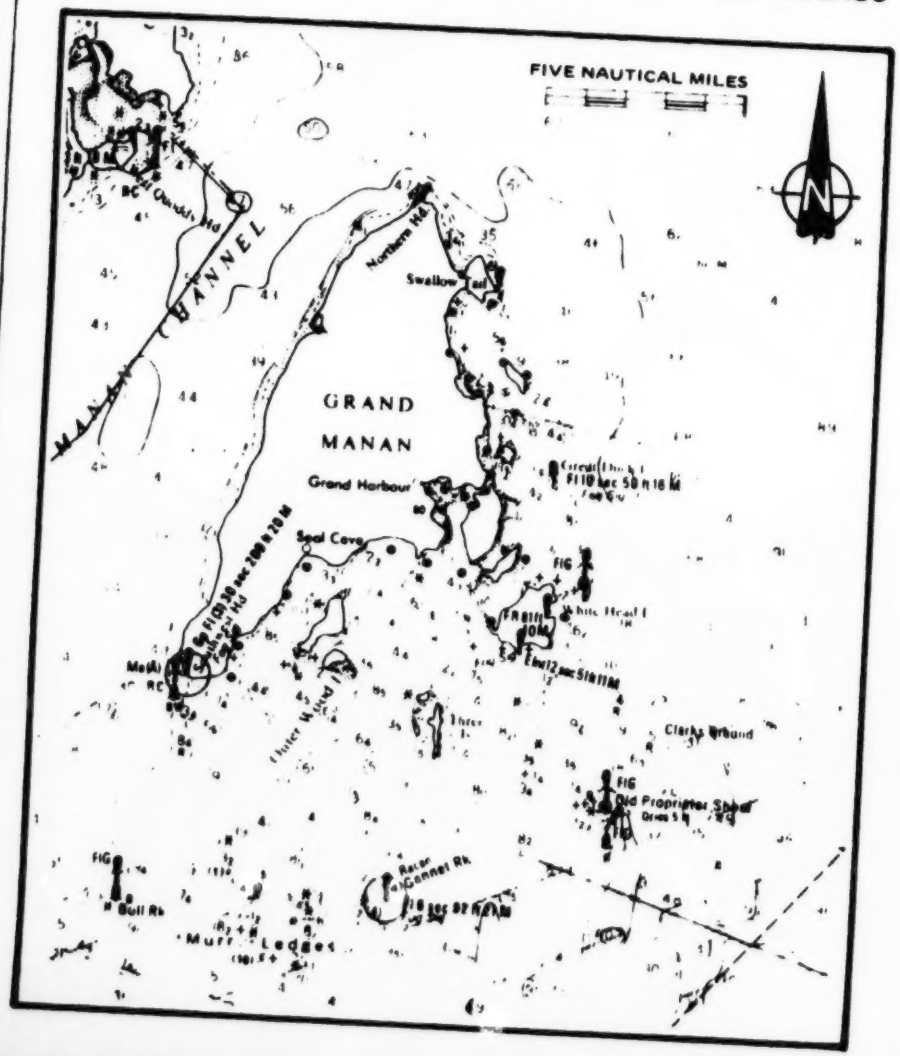
7.26.12
DISTRIBUTION OF ROCKWEED
(Ascophyllum)

THE GRAND MANAN ARCHIPELAGO



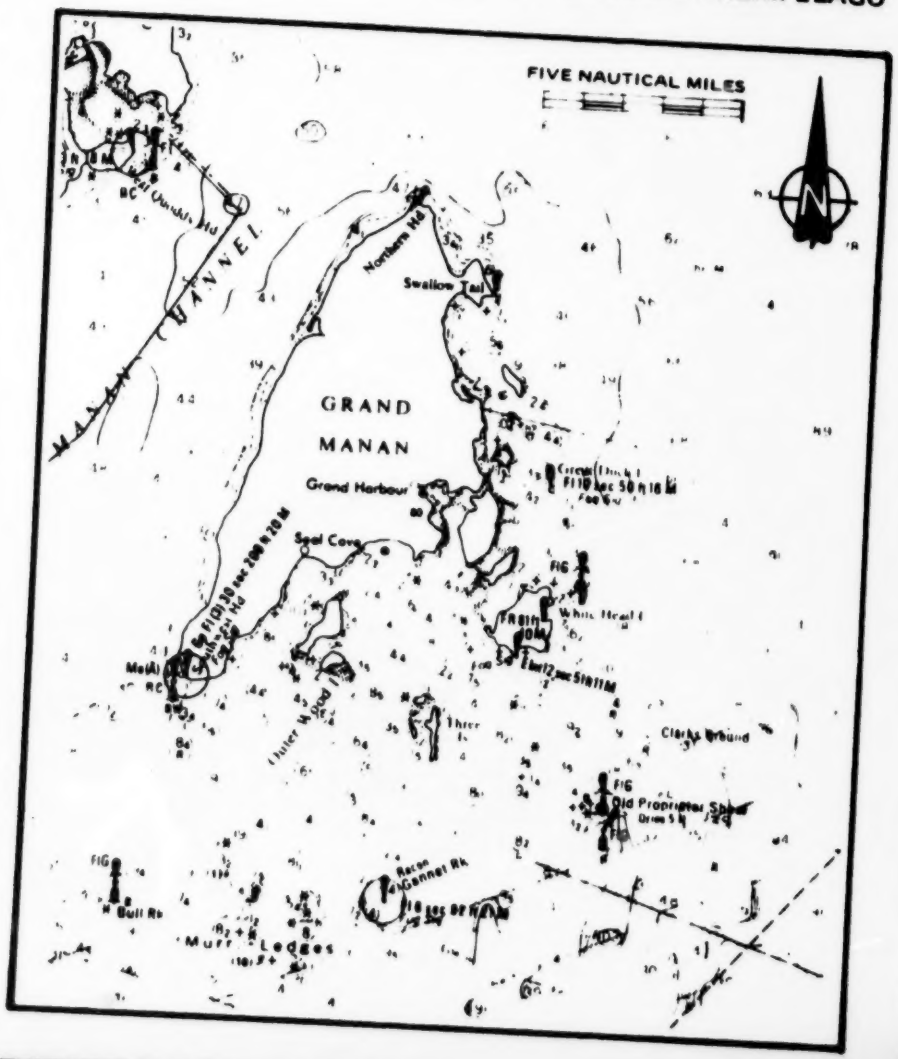
7.26.13
DISTRIBUTION OF ROCKWEED
(Fucus vesiculosus)

THE GRAND MANAN ARCHIPELAGO



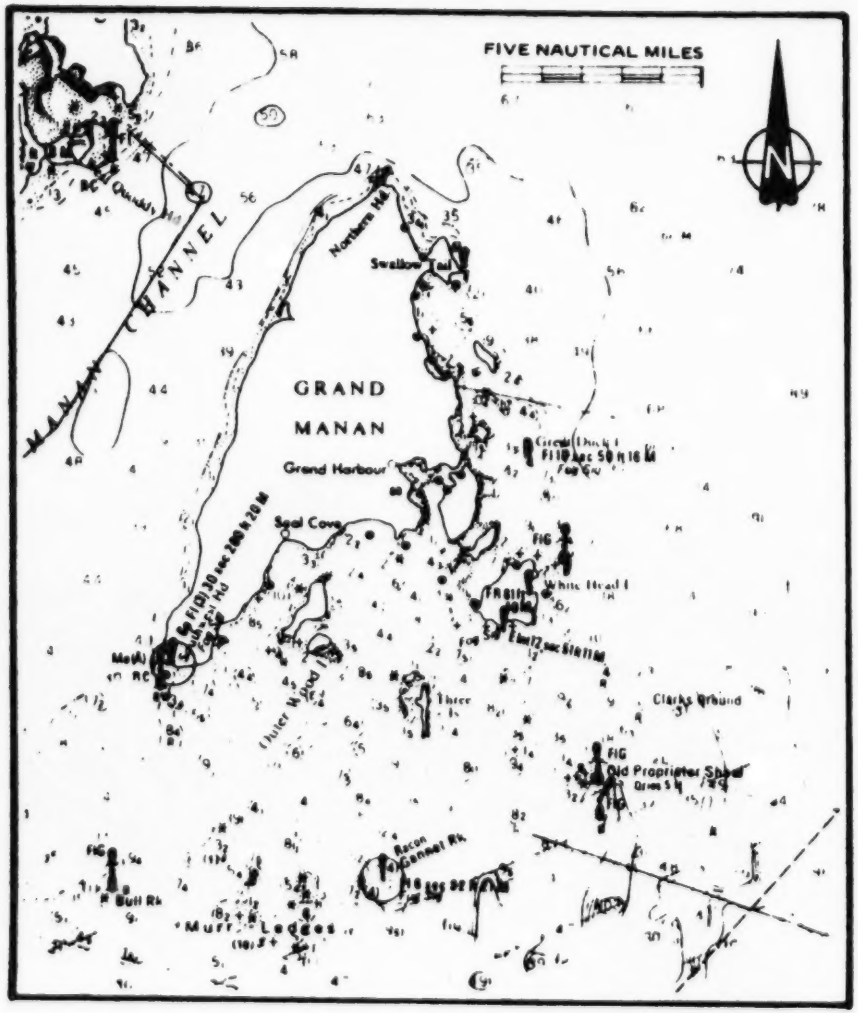
7.26.14
DISTRIBUTION OF ROCKWEED
(Fucus spiralis)

THE GRAND MANAN ARCHIPELAGO



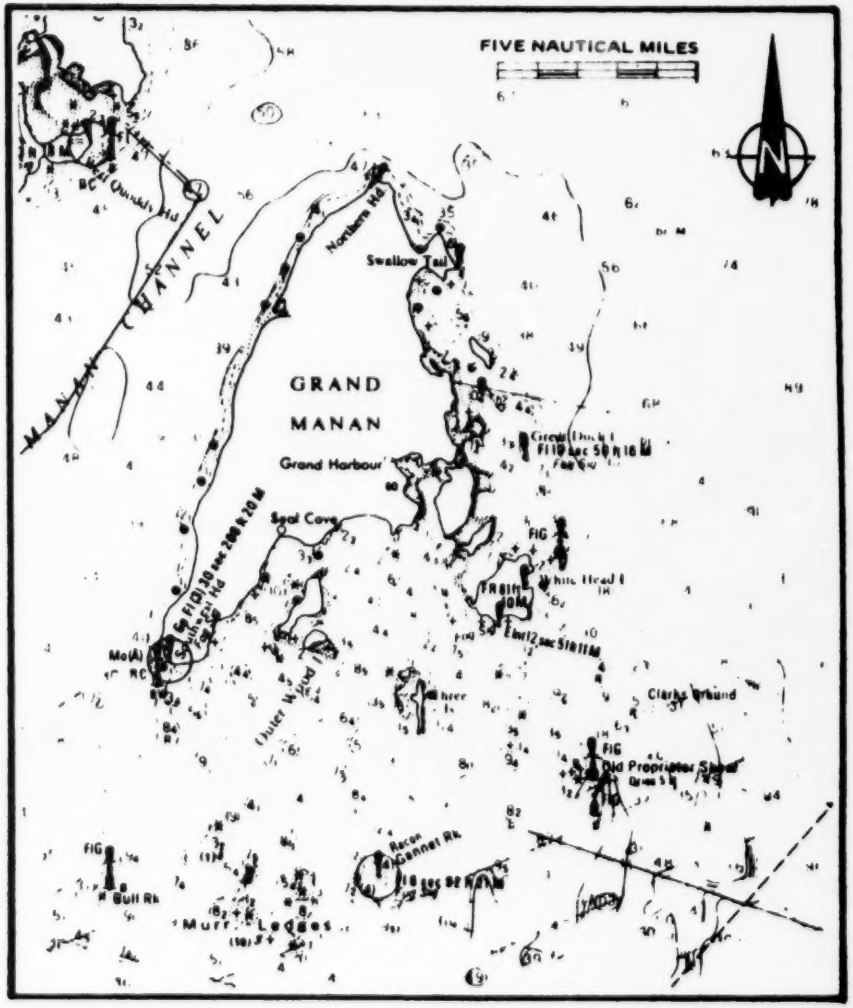
7.26.15
DISTRIBUTION OF ROCKWEED
(Fucus edentatus)

THE GRAND MANAN ARCHIPELAGO

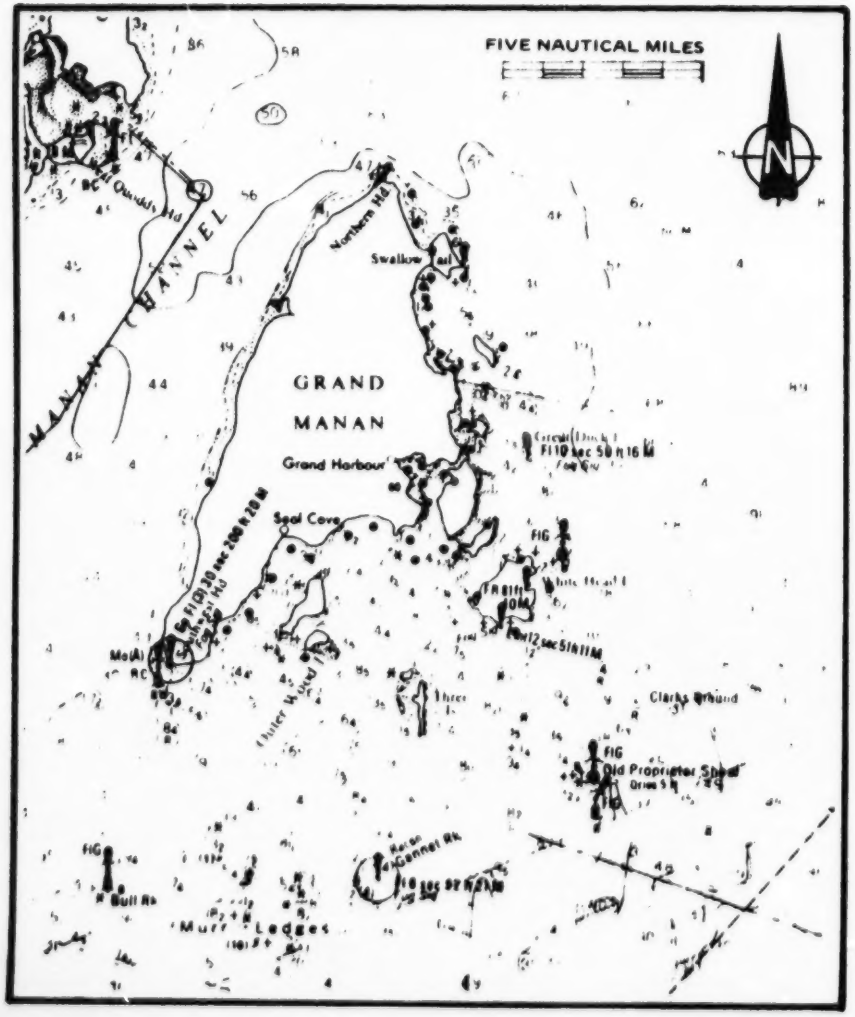


7.26.16
DISTRIBUTION OF THE ALGA
DESMERESTIA

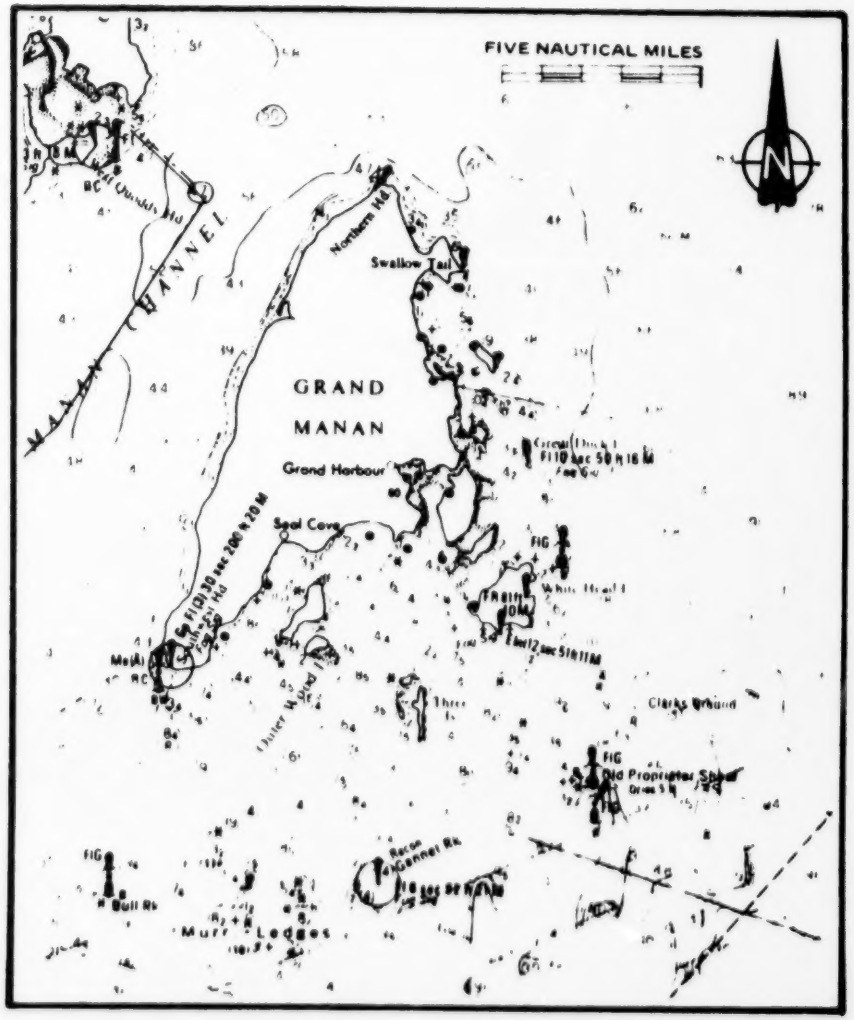
THE GRAND MANAN ARCHIPELAGO



7.26.17
DISTRIBUTION OF SEA LETTUCE
THE GRAND MANAN ARCHIPELAGO

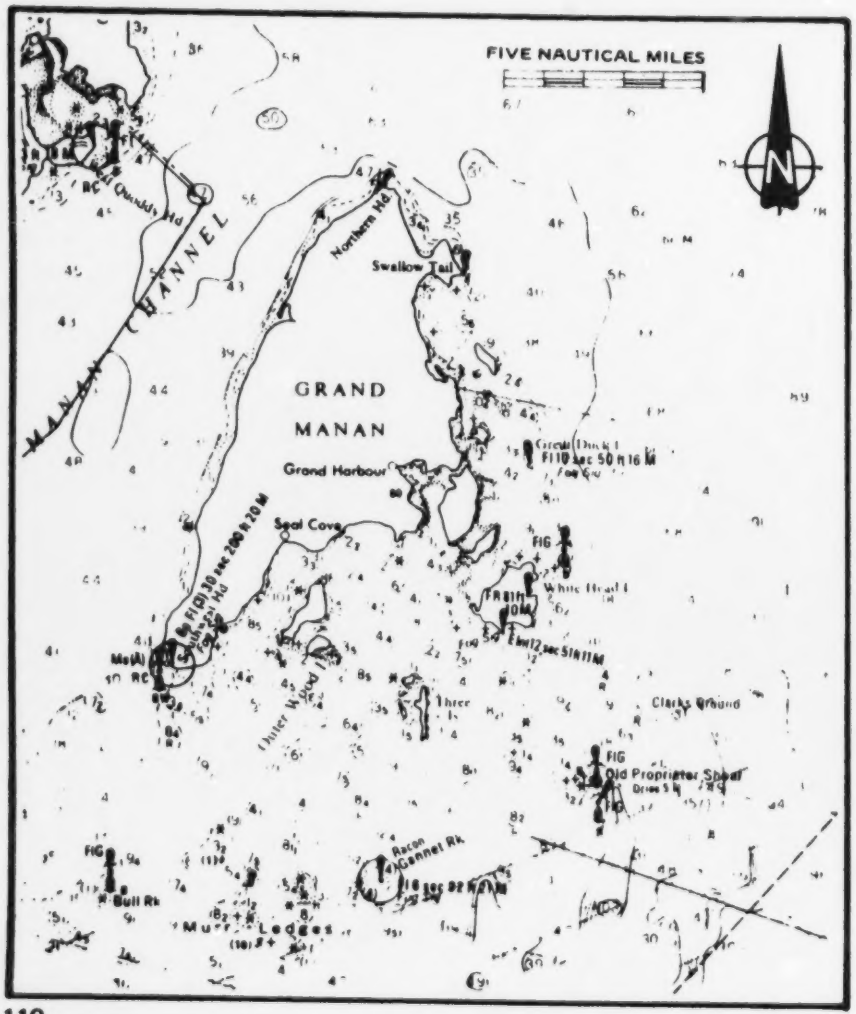


7.26.18
DISTRIBUTION OF THE ALGA ENTEROMORPHA
THE GRAND MANAN ARCHIPELAGO



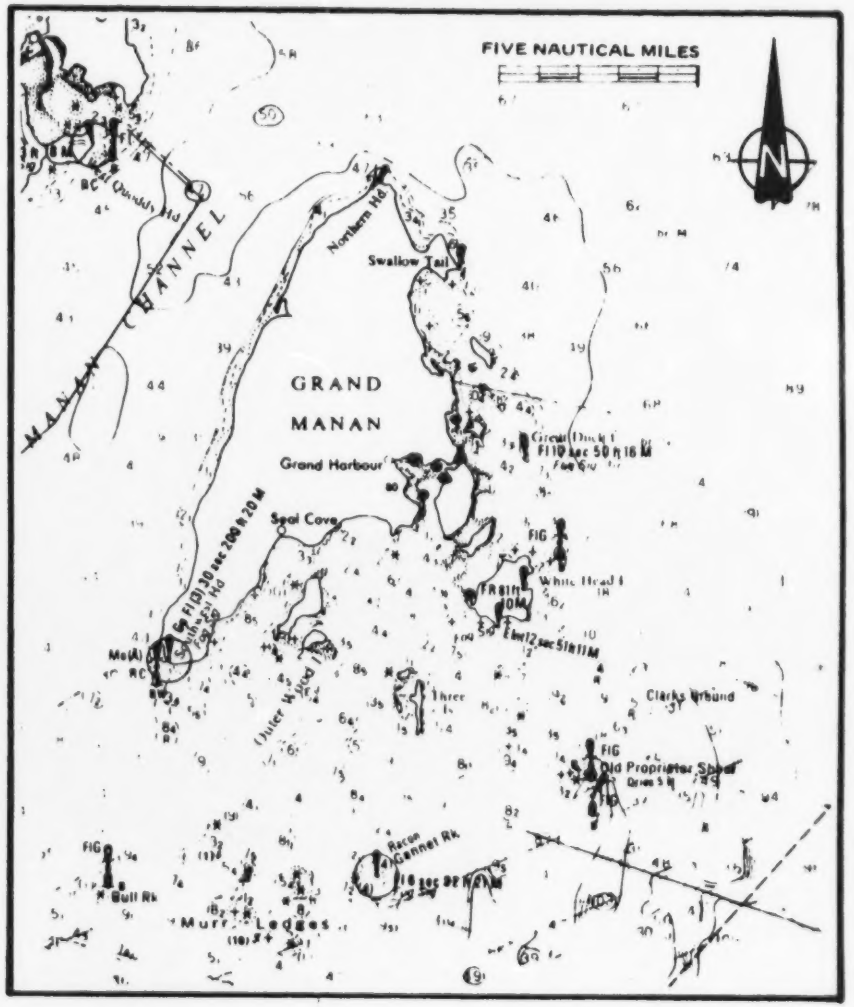
7.26.19
DISTRIBUTION OF THE ALGA
SPONGOMORPHA

THE GRAND MANAN ARCHIPELAGO



7.26.20
DISTRIBUTION OF EEL GRASS

THE GRAND MANAN ARCHIPELAGO



8. ECOLOGICAL EVALUATION

8.1 INTRODUCTION

The Grand Manan Archipelago lies well offshore at the mouth of the Bay of Fundy and, consequently, exhibits many of the characteristics of oceanic islands. The main island has considerable variation in habitats with a number of major embayments such as Grand Harbour, providing mixed substrates and mud. Sand bottom is common in shallow water throughout the area, as is rocky bottom. Deep water surrounds the islands. Consequently pelagic fish, birds and mammals are common.

8.2 COMMUNITIES OF THE SHALLOW WATER OR NERITIC ZONE

An analysis of organism-substrate relationships indicates the following breakdown:

	No.	% of Total Species
Rocky substrate species	45	36.9%
Mixed substrate species	52	42.6%
Sand/mud substrate species	25	20.5%
	122	100%

As can be seen, the Grand Manan fauna shows mixed affinities with a high percentage of animals and plants being capable of growth on mixed bottoms, an elevated mud-sand component compared to other areas and a corresponding percentage reduction in rocky substrate organisms.

Figures 8.2.1 to 8.2.9 show typical zonation and modes of occurrence for various substrates in the study area.

An analysis in terms of feeding method revealed the following composition:

	% of Total
Plankton/Suspension feeders	43.6%
Detritus feeders	21.4%
Predators/Scavengers	28.2%
Grazers	6.8%
	100%

These figures indicate moderate plankton and detritus levels. Grazers are not relatively common, but species occurring in the study area tend to be abundant in certain localities. Predators and scavengers are at about the same level as elsewhere in the mouth of the Bay of Fundy.

8.3 COMMUNITIES OF THE PELAGIC ZONE

Pelagic fish, birds and mammals are more common in the Grand Manan area than in any of the other areas studied in this survey.

8.4 COMMUNITIES OF THE DEEP WATER OR BATHYAL ZONE

To our knowledge, no deep water studies have been carried out in the study area. However, we would expect many of the species discovered near Point Lepreau to occur here as well. The reader is referred to Volume 6 of this series for further information.

8.5 PRODUCTIVITY

An analysis of productivity in terms of the distribution and abundance of benthic invertebrates indicates a moderate level of productivity (Figure 8.5.1) compared to other areas such as the Wolves and Head Harbour Passage area.

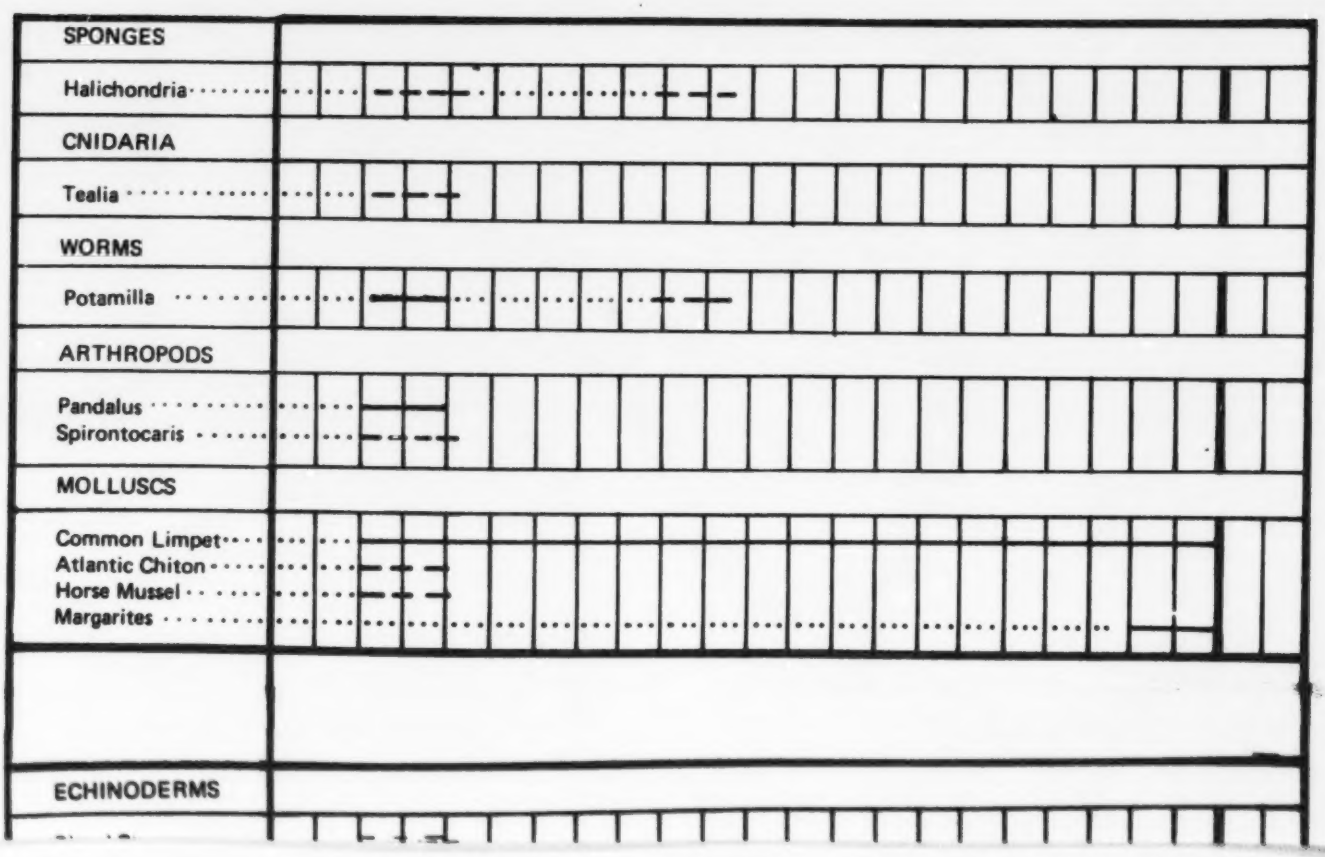

SPONGES
Halichondria
CNIDARIA
Tealia
WORMS
Potamilla
ARTHROPODS
Pandalus
Spirontocaris
MOLLUSCS
Common Limpet
Atlantic Chiton
Horse Mussel
Margarites
ECHINODERMS

FIGURE 8.2.1 TRANSECT T1, GRAND MANAN CHANNEL NEAR PANDORA HEAD.

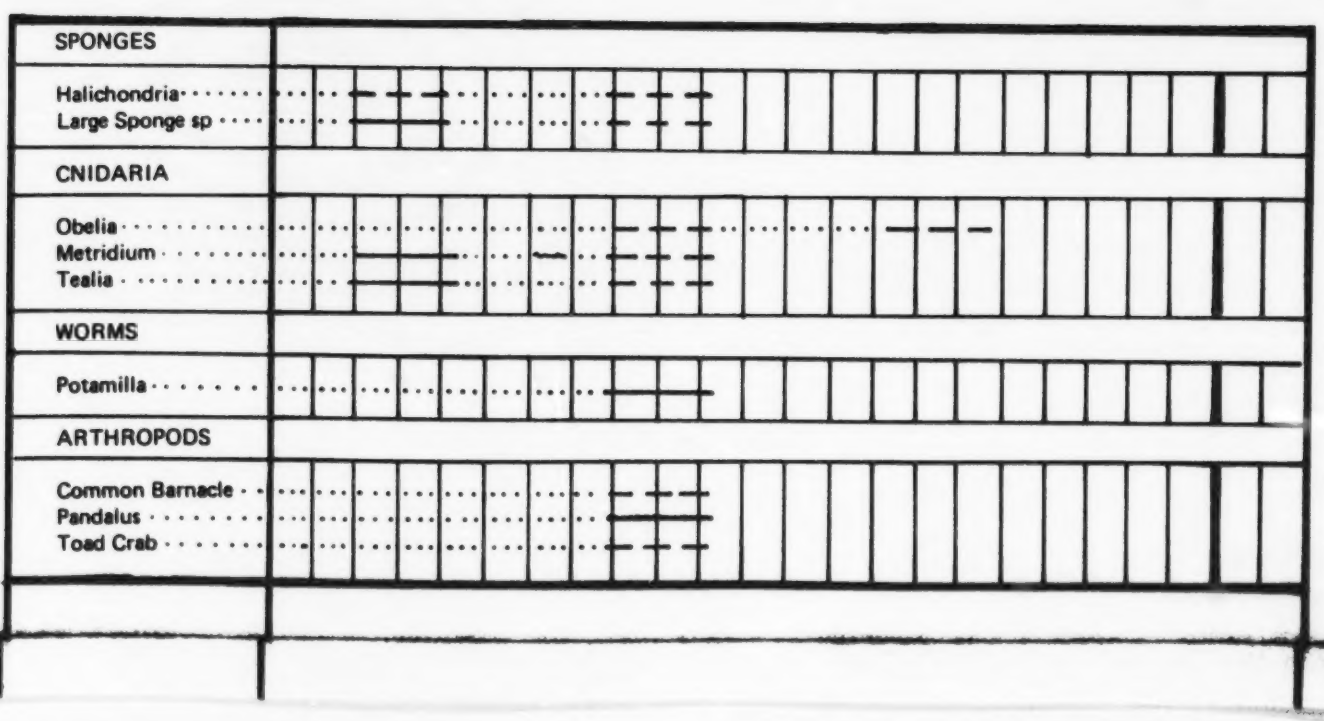

SPONGES
Halichondria
Large Sponge sp
CNIDARIA
Obelia
Metridium
Tealia
WORMS
Potamilla
ARTHROPODS
Common Barnacle
Pandalus
Toad Crab

FIGURE 8.2.2 TRANSECT
T2, GRAND MANAN
CHANNEL NEAR DARK
HARBOUR.

FIGURE 8.2.3 TRANSECT
T3, LONG ISLAND BAY,
GRAND MANAN, N.B.

PRESENT
COMMON
ABUNDANT
SEA URCHIN
ALARIA
LITHOTHAMNION
ULVA
DEVIL'S APRON
(Laminaria)

FIGURE 8.2.4 TRANSECT T4 - NORTH END OF CHENEY PASSAGE, GRAND MANAN, N.B.

PRESENT — — —
COMMON ———
ABUNDANT ▬▬

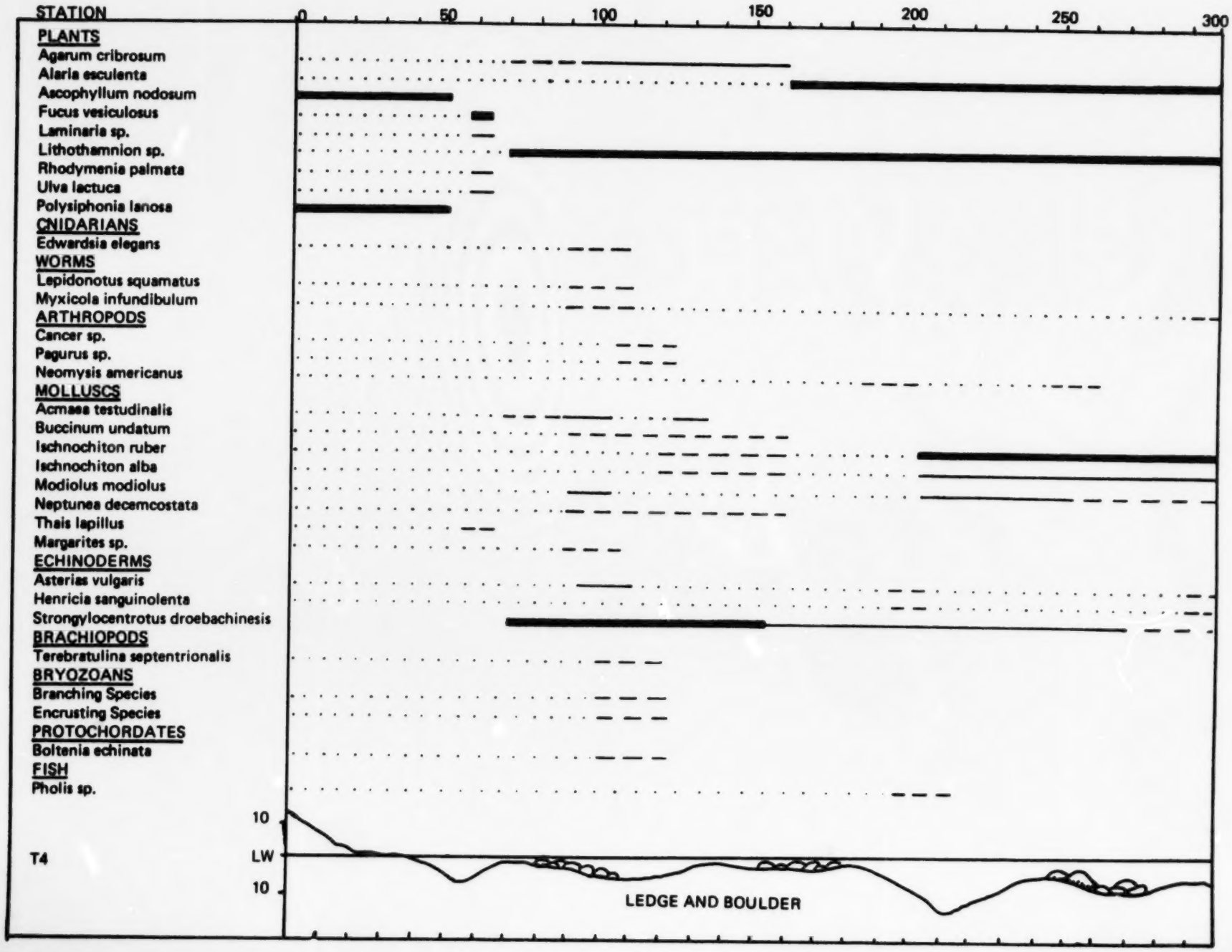

STATION
0
50
100
150
200
250
300
PLANTS
Agarum cribrosum
Alaria esculenta
Ascophyllum nodosum
Fucus vesiculosus
Laminaria sp.
Lithothamnion sp.
Rhodymenia palmata
Ulva lactuca
Polysiphonia lanosa
CNIDARIANS
Edwardsia elegans
WORMS
Lepidonotus squamatus
Myxicola infundibulum
ARTHROPODS
Cancer sp.
Pagurus sp.
Neomysis americanus
MOLLUSCS
Acmaea testudinalis
Buccinum undatum
Ischnochiton ruber
Ischnochiton alba
Modiolus modiolus
Neptunea decemcostata
Thais lapillus
Margarites sp.
ECHINODERMS
Asterias vulgaris
Henricia sanguinolenta
Strongylocentrotus droebachinesis
BRACHIOPODS
Terebratulina septentrionalis
BRYOZOANS
Branching Species
Encrusting Species
PROTOCHORDATES
Boltenia echinata
FISH
Pholis sp.
10
LW
10
T4
LEDGE AND BOULDER

FIGURE 8.2.5 TRANSECT T5 - NORTH END OF COW PASSAGE , GRAND MANAN, N.B.

PRESENT — — —
COMMON ————
ABUNDANT ▬▬▬

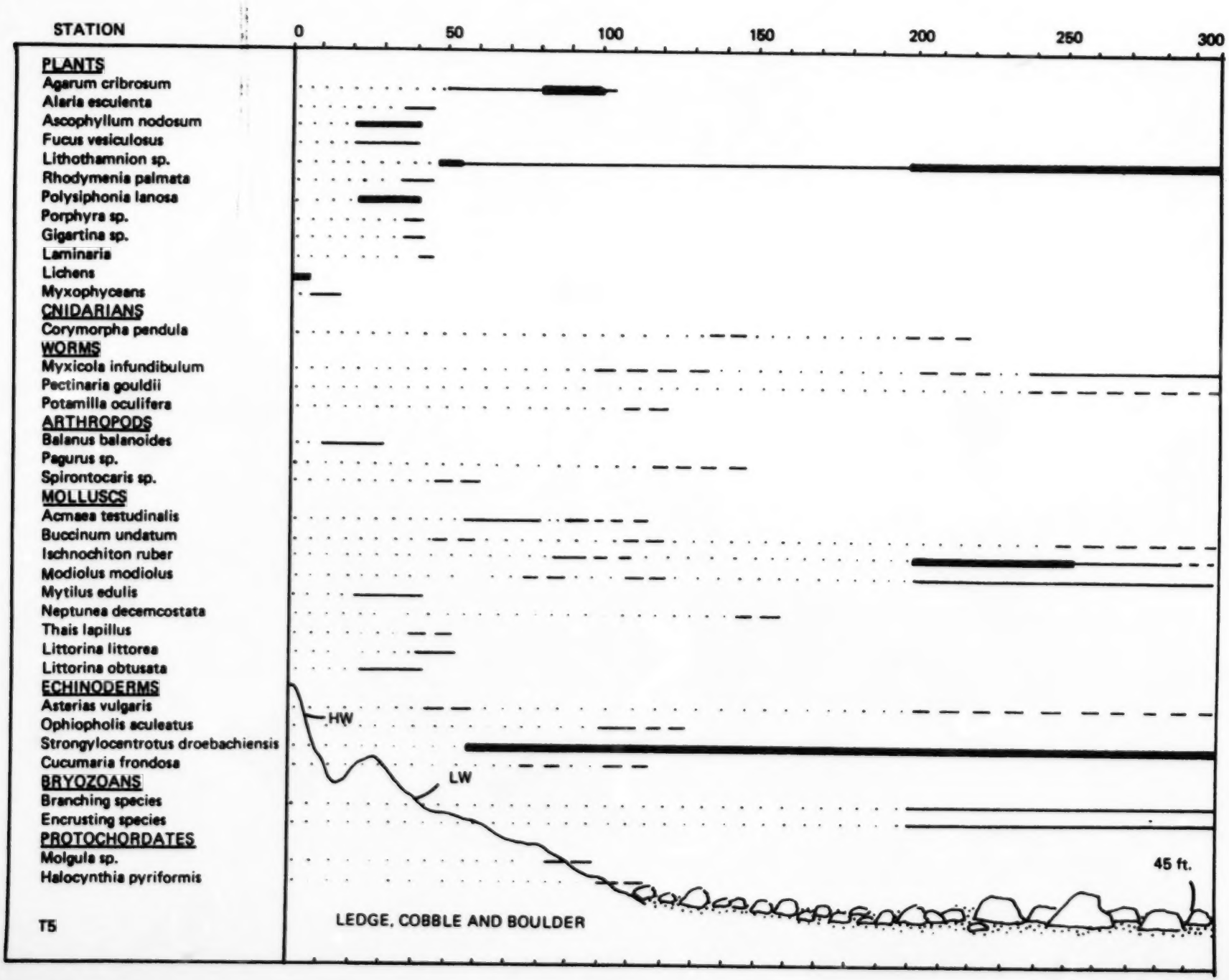

STATION
0
50
100
150
200
250
300
PLANTS
Agarum cribrosum
Alaria esculenta
Ascophyllum nodosum
Fucus vesiculosus
Lithothamnion sp.
Rhodymenia palmata
Polysiphonia lanosa
Porphyra sp.
Gigartina sp.
Laminaria
Lichens
Myxophyceans
CNIDARIANS
Corymorpha pendula
WORMS
Myxicola infundibulum
Pectinaria gouldii
Potamilla oculifera
ARTHROPODS
Balanus balanoides
Pagurus sp.
Spirontocaris sp.
MOLLUSCS
Acmaea testudinalis
Buccinum undatum
Ischnochiton ruber
Modiolus modiolus
Mytilus edulis
Neptunea decemcostata
Thais lapillus
Littorina littorea
Littorina obtusata
ECHINODERMS
Asterias vulgaris
Ophiopholis aculeatus
Strongylocentrotus droebachiensis
Cucumaria frondosa
BRYOZOANS
Branching species
Encrusting species
PROTOCHORDATES
Molgula sp.
Halocynthia pyriformis
HW
LW
45 ft.
T5
LEDGE, COBBLE AND BOULDER

FIGURE 8.2.6 TRANSECT T6 - BROWN'S POINT, CHENEY PASSAGE, GRAND MANAN, N.B.

PRESENT — — —
COMMON ————
ABUNDANT ▬▬▬

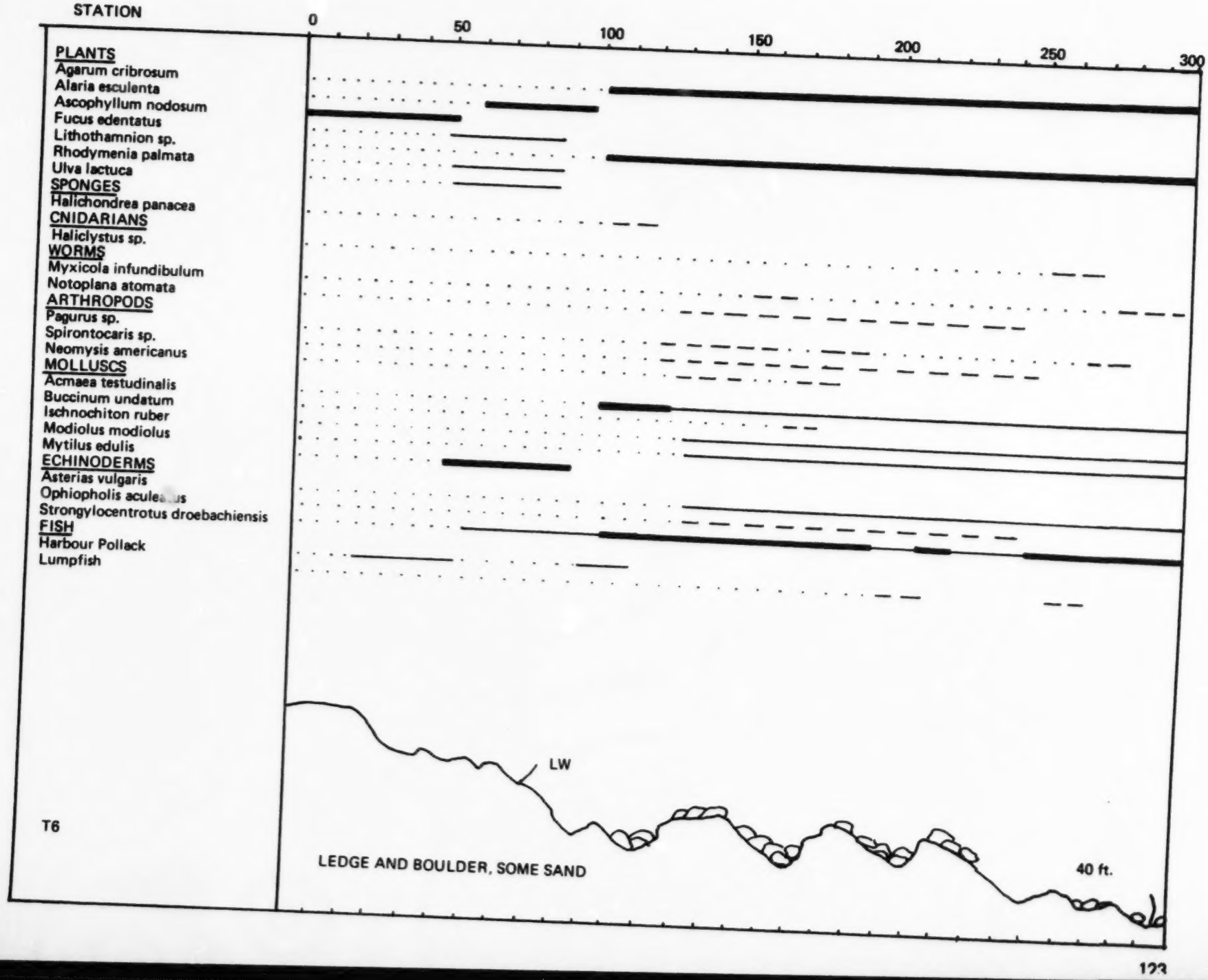

STATION
0
50
100
150
200
250
300
PLANTS
Agarum cribrosum
Alaria esculenta
Ascophyllum nodosum
Fucus edentatus
Lithothamnion sp.
Rhodymenia palmata
Ulva lactuca
SPONGES
Halichondrea panacea
CNIDARIANS
Haliclystus sp.
WORMS
Myxicola infundibulum
Notoplana atomata
ARTHROPODS
Pagurus sp.
Spirontocaris sp.
Neomysis americanus
MOLLUSCS
Acmaea testudinalis
Buccinum undatum
Ischnochiton ruber
Modiolus modiolus
Mytilus edulis
ECHINODERMS
Asterias vulgaris
Ophiopholis aculeatus
Strongylocentrotus droebachiensis
FISH
Harbour Pollack
Lumpfish
LW
T6
LEDGE AND BOULDER, SOME SAND
40 ft.

FIGURE 8.2.7 TRANSECT T7 - SAND BAR LEDGE, GRAND MANAN, N.B.

PRESENT — — —
COMMON ———
ABUNDANT ▬▬▬

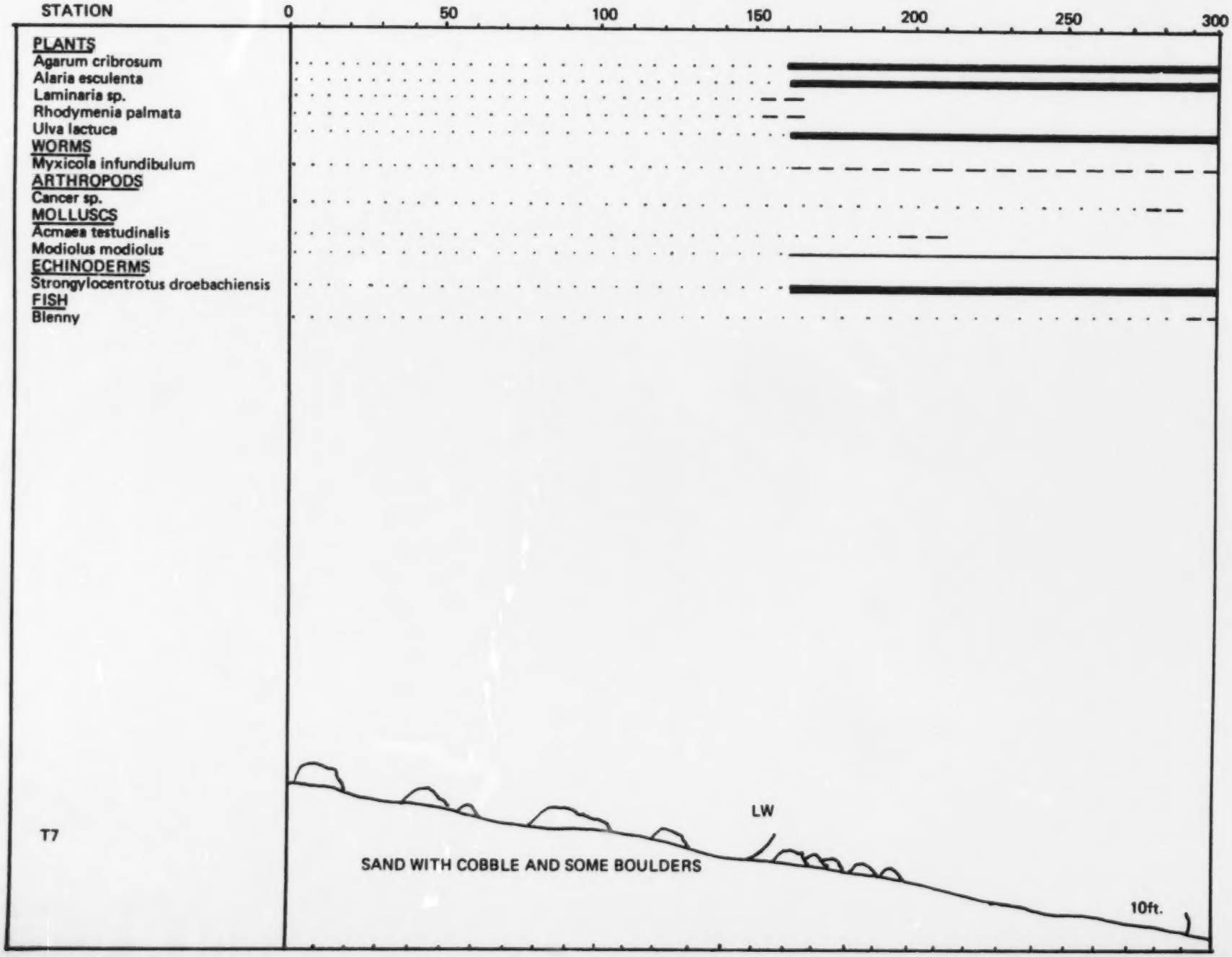

STATION
0
50
100
150
200
250
300
PLANTS
Agarum cribrosum
Alaria esculenta
Laminaria sp.
Rhodymenia palmata
Ulva lactuca
WORMS
Myxicola infundibulum
ARTHROPODS
Cancer sp.
MOLLUSCS
Acmaea testudinalis
Modiolus modiolus
ECHINODERMS
Strongylocentrotus droebachiensis
FISH
Blenny
LW
SAND WITH COBBLE AND SOME BOULDERS
10ft.
T7

FIGURE 8.2.8 TRANSECT T8 - BILL'S ISLET, CHENEY PASSAGE, GRAND MANAN, N.B.

PRESENT — — —
COMMON ————
ABUNDANT ▬▬▬

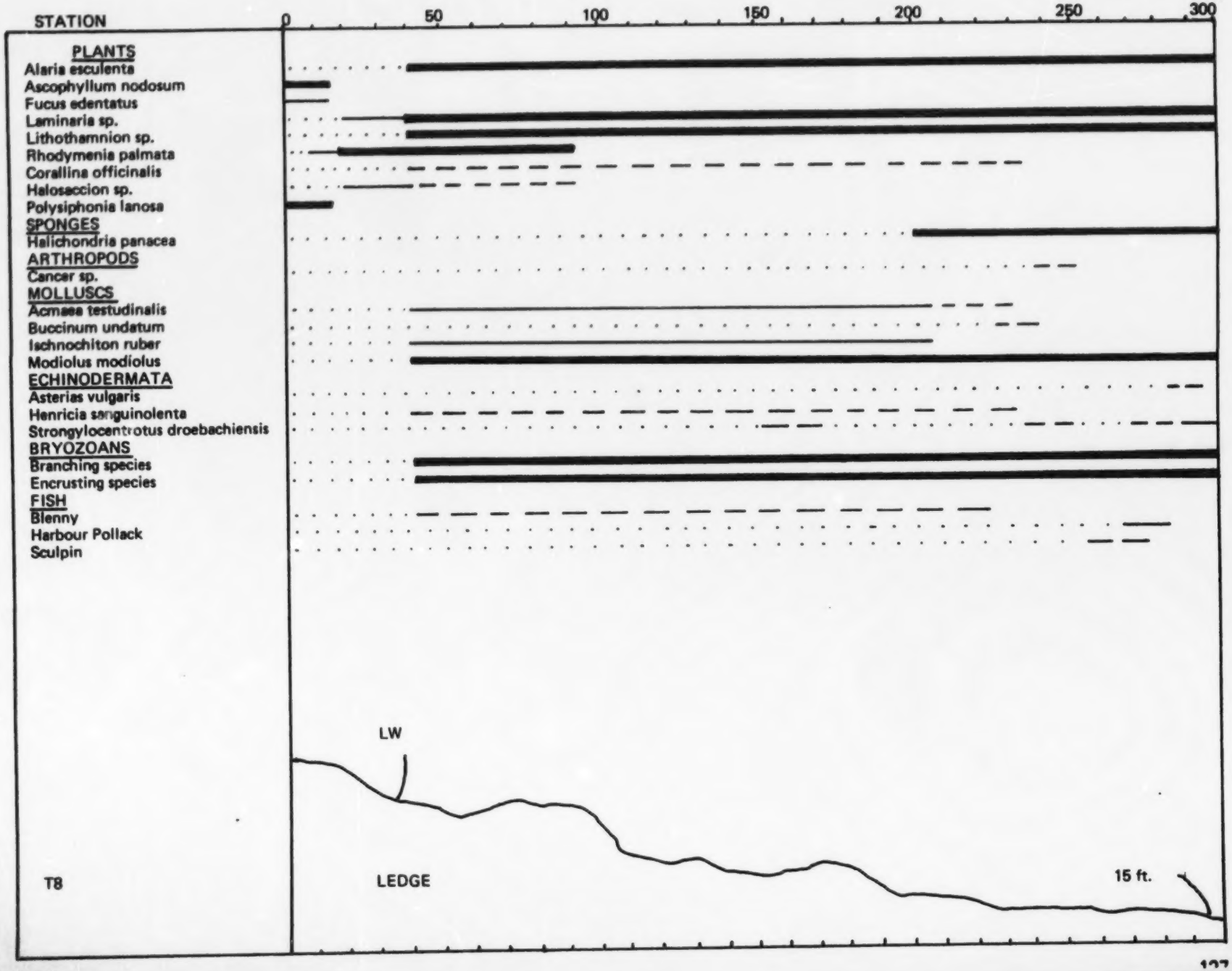
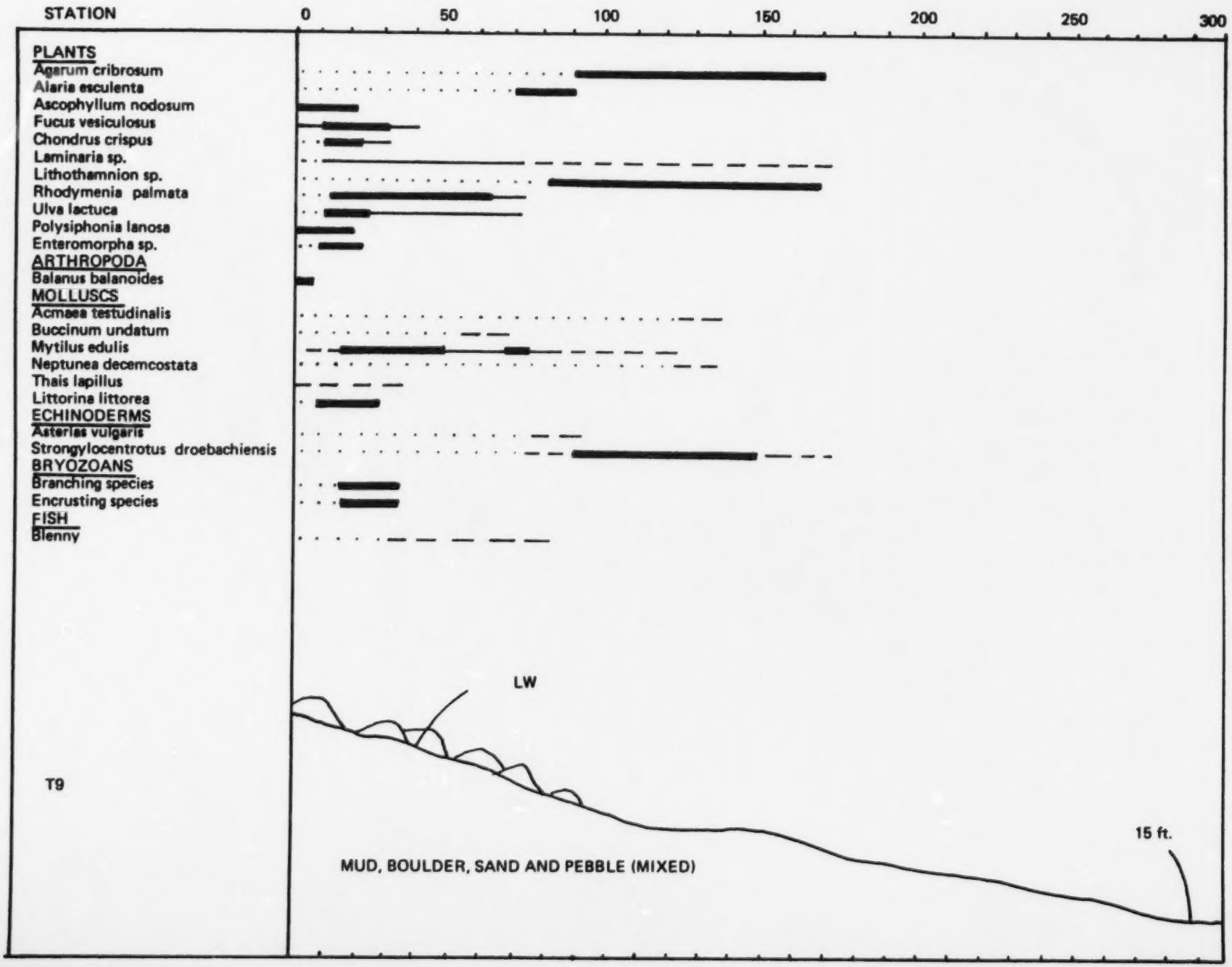
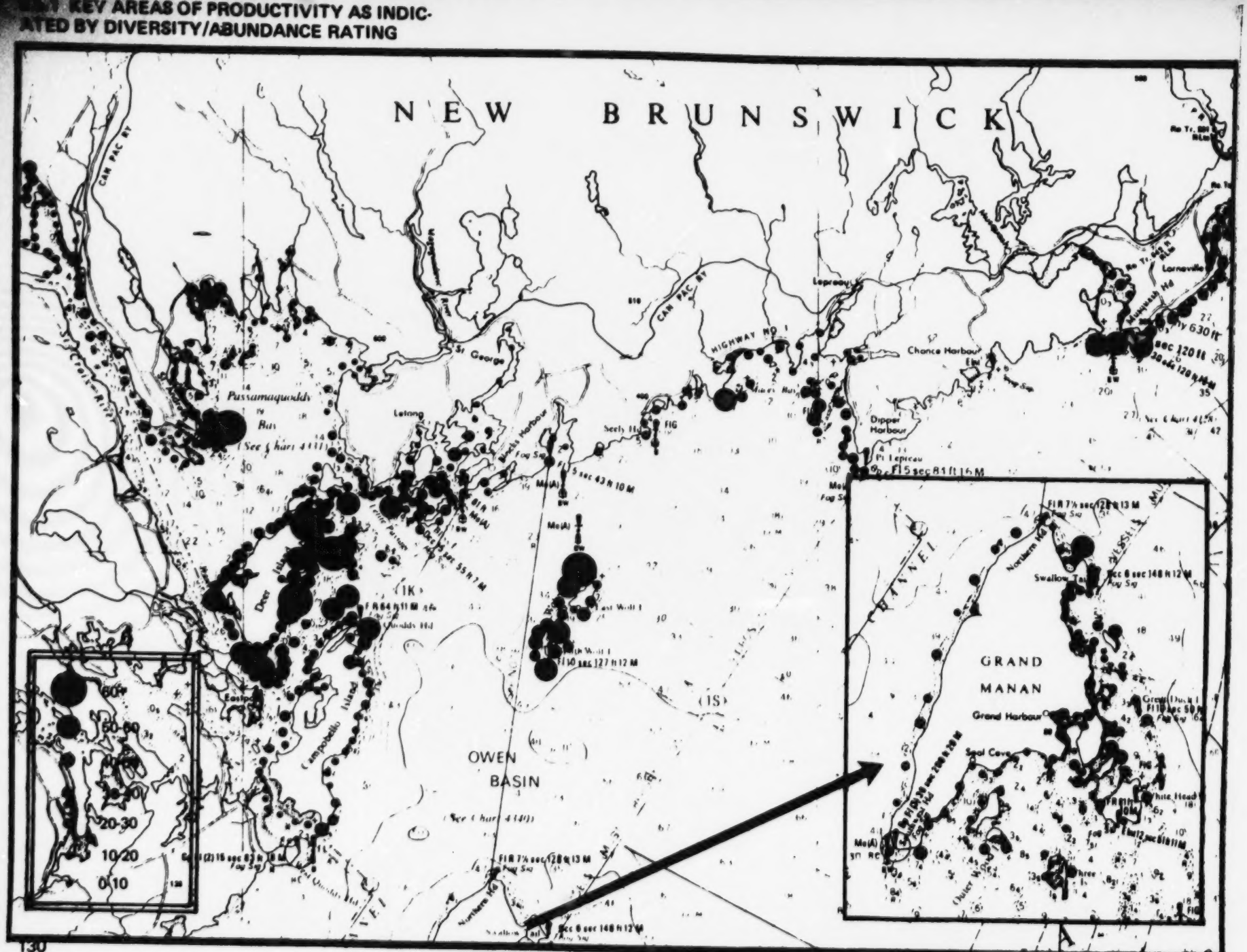

STATION
0
50
100
150
200
250
300
PLANTS
Alaria esculenta
Ascophyllum nodosum
Fucus edentatus
Laminaria sp.
Lithothamnion sp.
Rhodymenia palmata
Corallina officinalis
Halosaccion sp.
Polysiphonia lanosa
SPONGES
Halichondria panacea
ARTHROPODS
Cancer sp.
MOLLUSCS
Acmaea testudinalis
Buccinum undatum
Ischnochiton ruber
Modiolus modiolus
ECHINODERMATA
Asterias vulgaris
Henricia sanguinolenta
Strongylocentrotus droebachiensis
BRYOZOANS
Branching species
Encrusting species
FISH
Blenny
Harbour Pollack
Sculpin
LW
T8
LEDGE
15 ft.

FIGURE 8.2.9 TRANSECT T9 · SAM'S ISLET, GRAND MANAN, N.B.

PRESENT — — —
COMMON ———
ABUNDANT ■■■


STATION
0
50
100
150
200
250
300
PLANTS
Agarum cribrosum
Alaria esculenta
Ascophyllum nodosum
Fucus vesiculosus
Chondrus crispus
Laminaria sp.
Lithothamnion sp.
Rhodymenia palmata
Ulva lactuca
Polysiphonia lanosa
Enteromorpha sp.
ARTHROPODA
Balanus balanoides
MOLLUSCS
Acmaea testudinalis
Buccinum undatum
Mytilus edulis
Neptunea decemcostata
Thais lapillus
Littorina littorea
ECHINODERMS
Asterias vulgaris
Strongylocentrotus droebachiensis
BRYOZOANS
Branching species
Encrusting species
FISH
Blenny
LW
T9
15 ft.
MUD, BOULDER, SAND AND PEBBLE (MIXED)

4.3.1 KEY AREAS OF PRODUCTIVITY AS INDICATED BY DIVERSITY/ABUNDANCE RATING



9. THE FISHERY

9.1 GENERAL DESCRIPTION OF THE INDUSTRY

There is a rich and important fishery in the Grand Manan area and most coastal peoples there are dependent, as they have been for several centuries, on the fishery both in terms of economics and life style.

The major fisheries in the study area are herring, lobster and groundfish. Scallops, dulse and occasionally periwinkles are harvested seasonally to supplement incomes.

As of March 5, 1977 there were 161 licensed fishermen registered in Statistical District 50 (the Grand Manan area). (Fisheries and Marine Service Statistics). This figure does not, however, give a true picture of the entire fishing effort as these statistics do not include unlicensed fishermen or fishermen's helpers. The number of vessels registered in District 50 in 1978 was 163 (this figure included any vessels from 16 feet to 82 feet in length). (Fisheries and Marine Service Statistics).

The total value for all fisheries combined in District 50 for 1969-1975 was as follows: (Fisheries and Marine Service Statistics).

1969 - $1,311,652
1970 - $1,162,541
1971 - $1,121,721
1972 - $2,442,776
1973 - $2,215,123
1974 - $1,773,331
1975 - $2,305,027

Herring and groundfish processing plays an important role in the economy of the study area while lobster pounds also provide substantial employment

9.2 PROCESSING OPERATIONS AND RESEARCH ESTABLISHMENTS. The following is a list of existing processing operations in the study area:

1. Atlantic Mariculture Ltd., Castalia - Dulse
2. United Maritime Fishermen Ltd., Ingalls Head - Salt Fish
3. Fishermen of White Head (and of Grand Manan Island) - Salt Fish
4. Misty Island Fisheries Ltd., Seal Cove - Fresh and Salted Fish, Bloaters and Smoked Herring
5. H.B. Nickerson & Sons Ltd., Ingalls Head - Filleting Plant
6. Connors Bros. Ltd., Seal Cove - Herring processing
7. John L. Ingersoll and Sons Ltd., Woodwards Cove Smoked herring
8. Seafare, Woodwards Cove - Smoked herring (new - will begin operations in 1979).
9. Cove Seafoods Ltd., Woodwards Cove - Smoked herring
10. Green's Sea Products, Grand Harbour - Smoked herring
11. Morse and Zwicker, White Head - Bloaters
12. F. & J. Small Ltd., White Head - Bloaters
13. Helshiron Fisheries, Seal Cove - Bloaters
14. Ronald Boynton Fisheries Ltd., Seal Cove - Smoked herring and bloaters
15. Harvey Bleumortier, Seal Cove - Bloaters
16. James Small, Seal Cove Bloaters
17. Wayco Seafoods Ltd., Seal Cove Bloaters
18. Bernard O'Neill, Seal Cove, - Bloaters
19. Benson Lobster Co., Ltd. Lobster pounds (2)
20. Clearwater, between Grand Manan Island and Ross Island - Lobster pounds (3)
21. United Maritime Fishermen Ltd., Lobster pound (1)
22. Cook's Lobster pound (1)
23. Blair Robinson Ltd., Lobster pound (1)
24. Mourik's, White Head Inactive lobster pound (lobsters shipped out after purchasing)
25. Misty Island Fisheries Ltd., Grand Harbour Lobster pound (1)

9.3 PRINCIPAL FISHING AREAS. Areas which are important to the local fishery were documented and are presented in Figures 9.3.1 to 9.3.5.

9.4 ANNOTATED LIST OF SPECIES

INTRODUCTION. Where available, statistics for each fishery are provided. The value of these statistics is questionable however, since fish caught in one district are often landed in another one. This practice is determined by the location of processing facilities, markets, and the home port of the fishermen involved. Therefore it should be stressed that available statistical data do not reflect the value of any fishery in the study area and reflect only the general level of fishing activity in the Bay of Fundy as a whole. Available fish landings for the study area are given in Table 9.4 1

The following weir landings for 1977 were kindly supplied by the Marine Fish Division, Department of Fisheries and Oceans, St. Andrews, N.B.

	Herring Landings (tons)
District 49 (Saint John)	97.00
District 50 (Grand Manan)	6741.00
District 51 (Deer Island - 6892.00) (Campobello - 1531.00)	8423.00
District 52 (Western Charlotte)	1896.00
District 53 (Pea Pt. to Pt. Lepreau)	4445.00
Nova Scotia	5174.00

There were approximately 50 weirs in operation in the study area in 1977 (Fisheries and Marine Service Statistics). These data clearly demonstrate the relative importance of the study area in terms of the herring weir fishery.

MOLLUSCA

1. *Littorina littorea* (Common periwinkle). This is a part-time fishery with sporadic landings. Table 9.4.1 gives recorded landing data for the period 1947 to 1975. Periwinkles are common at a number of localities and occur throughout the study area. Harvesting is done by hand at low tide and some attempts have been made at trapping and dragging (Cook 1976). It is estimated that in 1975 - 137 periwinkle "pickers" landed to the area's major buyer, about 50,000 pounds of winkles which sold from 18 to 20 cents per pound (Cook, 1976). Caddy and Chandler (1976) suggest that periwinkles appear to be a substitute for clams on certain markets, the major markets being in Montreal and New England.

2. *Buccinum undatum* (Northern Whelk). This edible whelk has not been exploited in the study area. It is present in certain areas but it is questionable whether sustained yields would justify a fishery. Elsewhere, they are fished using strings of baited traps and are also caught in lobster traps (Caddy, Chandler, Wilder, 1974).

3. *Mytilus edulis* (Blue mussel). The common edible blue mussel is readily available in the study area but suffers from lack of market. Seasonal toxicity levels restrict the taking of mussels in the study area. Statistical data for the years 1969-1975 indicate there were no mussels landed.

3. *Volsella (modiolus) modiolus* (Horse mussel). The horse mussel has never been marketed in the Canadian Maritimes (Caddy, et. al, 1974) although it does occur in the study area. They can be harvested by hand on low spring tides, dragged subtidally, or harvested by scuba divers.

5. *Placopecten magellanicus* (Giant Sea Scallop). Scallops are present in the study area but not abundant enough to sustain a large fishery at present. Most scallops are harvested in the winter to supplement incomes. Landings for the Grand Manan area for the years 1947-1975 are given in Table 9.4.1. Most scallops are harvested by drags, although some landings are made by scuba divers.

6. *Mya arenaria* (Soft-shelled clam). The clam fishery in the study area has steadily declined since the early 1950's. In fact, since 1957 only 3 landings (1959, 1966 and 1971) are reported. Table 9.4.1 shows the available clam landings. "Closures due to toxicity, over-fishing, and a reduced effort due to such things as UIC benefits could account for the sudden decline in landings in the late 1950's" (Caddy and Chandler, 1976).

7. *Arctica islandica* (Ocean quahog). There is no existing fishery in the study area and this species has not been utilized commercially in the past. At one site in the study area, however, this species was common.

8. *Ilex illecebrosus* (Squid). Squid are occasionally abundant in the study area and although there have been landings, no steady market has developed. Because markets are known to exist, further investigations could be useful since this species is readily caught in large quantities by local fish draggers and in weirs.

ANNELIDA

1. *Nereis virens* (Sandworms). This species is present at a limited number of sites in the study area. The flats at these sites, however, are not extensive enough to support any large scale commercial operation.

2. *Myxicola infundibulum* (Feathered fan worm). This annelid commonly occurs in the study area. It is currently harvested by MRA for use in research and information on harvesting and marketing can be found in MacKay (1977).

ARTHROPODA

1. *Meganyctiphanes norvegica* (Krill, Euphausid shrimp). This species is abundant on a seasonal basis in the study area and is commercially utilized by other countries. Further investigations should be made to determine the feasibility of establishing a fishery. Research is also required into harvesting and processing methods.

2. *Pandalus borealis* and *P. montagui* (Commercial shrimp). Some commercial shrimp fishing has taken place in the study area in the past. Table 9.4.1 shows a record of shrimp landings for the area. It is felt that the sharp decline in landings in the early 1970's resulted as original stocks were depleted (Caddy and Chandler, 1976). Shrimp are usually

caught in a specially constructed trawl but some attempts have been made to capture them in retangular metal traps.

3. *Homarus americanus* (American lobster). A good commercial fishery for lobster exists in the study area. It is estimated that for the years 1970-1974 inclusive a total catch of 3,582,000 pounds of lobsters contributed close to $4,408,000 to the livelihood of the area's lobster fishermen (Fisheries Statistics Branch, Environment Canada, Halifax, N.S. May, 1975). Lobsters are fished using standard lobster traps during regulated seasons (November 15 to June 24).

4. *Cancer borealis* (Rock Crab). Rock crabs are commonly caught as a by-product in lobster traps in the study area. However, due to lack of market this species is usually discarded. There are no official landings recorded for the study area although small quantities are occasionally taken for domestic use. Because they are caught along with lobster in the same traps and are handled anyway, a market would produce immediate landings and this potential fishery is therefore worthy of further investigation.

ECHINODERMATA

1. *Strongylocentrotus droebachiensis* (Sea Urchin). As indicated in a survey of the sea urchin roe industry (MacKay, 1976) a good market for sea urchin roe exists. Urchins are abundant in the survey area and they are harvested using scallop drags, divers, traps, tassel drags, manual shore collection and surface rakes. Statistics for the period 1969-1975 indicate landings of 222,000 pounds in 1970 and 327,000 pounds in 1974 in the study area (Fisheries and Marine Service Statistics).

CHORDATA

1. *Squalus acanthus* (Dogfish). Dogfish are a common species in the study area on a seasonal basis when they become an undesirable part of fish draggers and weir fishermen's catches. Although used in other countries as food fish no markets have been established at present. Statistics for the period 1969-1975 show a landing of 1,129 pounds in 1972 in the study area (Fisheries and Marine Service Statistics).

2. *Raja sp.* (Skate). Skate are commonly caught by fish draggers in the study area but no market currently exists.

3. *Clupea harengus harengus* (Atlantic herring). The Atlantic herring fishery is one of the most valuable fisheries in the study area contributing to the economy of the region an estimated $3,657,000 for the years 1970-1974 inclusive (Fisheries Statistics Branch, Environment Canada, Halifax, N.S., May, 1975). Available herring landings are shown in Table 9.4.1. Approximately 50 herring weirs are built each year in the study area and herring are also caught in "shut-off seines", and by purse seine.

The Grand Manan, (including Grand Manan Banks) herring purse seine fishery landings for 1972 and 1973 were estimated to be 32,153 tons and 25,155 tons respectively (Miller and Iles, 1975). Table 9.4.2 summarizes some aspects of the Grand Manan weir fishery for the period 1957-1962 (after Iles, 1975).

4. *Gadus morhua* (Cod). Cod are fished commercially by fish drag, trawl, gillnet, long-line and handline in the study area. Available landings for the study area for 1970-1975 are given in Table 9.4.1.

5. *Melanogrammus aeglefinis* (Haddock). Haddock are fished commercially by fish drag, trawl, long-line, gillnet and handline in the study area. Haddock landings for the study area are given in Table 9.4.1 for 1970-1975.

6. *Pollachius virens* (Pollock). Pollock are fished commercially by fish drag, trawl, gillnet, long-line and handline in the study area. Available landings are shown in Table 9.4.1 for the period 1970-1975.

7. *Scomber scombrus* (Atlantic mackerel). Mackerel have been an occasional catch in the weirs of the study area and, in the past, have been sold for fertilizer or fish meal. Mackerel landings for the years 1969-1975 are shown in Table 9.4.1.

8. *Hippoglossus hippoglossus* (Atlantic halibut). The Atlantic halibut is occasionally caught by fish drag, trawl, long-line, gillnet and handline in the study area. Halibut landings for the years 1969 to 1975 are given in Table 9.4.1.

9. *Brosme brosme* (Cusk). Only two small cusk landings are recorded for the period 1969 to 1975 (see Table 9.4.1). They are, however, an occasional by-catch with the main groundfish species and do occur in the study area.

10. *Anarhichas lupus* (Catfish or Atlantic Wolffish). Table 9.4.1 shows catfish landings in the study area for the period 1969-1975. Although not plentiful they, too, are an occasional by-catch of the groundfishermen.

11. *Hake* (unspecified). Unspecified species of hake are also occasionally caught in the study area Available landings are shown in Table 9.4.1.

12. Flatfish (unspecified). Varying species of flounder do occur in the study area and they have, in the past, been fished commercially mainly by fish draggers. Table 9.4.1 gives landings for the years 1969-1975 for the survey area.

ALGAE

1. *Chondrus crispus* (Irish moss). Irish moss is common in the study area but has never been commercially harvested. According to Neish (1973) "Irish moss was found in quantities far too small to permit commerical exploitation in Charlotte County". A landing of 4,496 pounds in 1972 (Fisheries and Marine Service Statistics) may suggest experimental harvesting.

2. *Rhodymenia palmata* (Dulse). Since dulse is common in the study area (a mean of 0.9 pounds per square foot on Dark Harbour Bar in good dulsing areas, Neish, 1973), an active harvesting industry exists in the Grand Manan area at present. Neish also estimated that the current dulse harvesting industry in Charlotte County is operating at only about 10% of its probable sustainable yield. Available dulse landings for the area appear in Table 9.4.1.

3. *Halosaccion spp. Halosaccion* is present in the study area but is not harvested commercially as it has no known commercial use.

4. *Porphyra sp.* (Red algae). Porphyra is present, but not extensive, in the study area. However, because of its high market values (in 1973, $32.00 per dry pound, Neish, 1973), it is worthy of examination for a fishery or culturing purposes.

5. *Laminaria sp.* (Kelp). Wide frond *Laminaria longicruris* is relatively common in the study area with the extent of beds around Grand Manan estimated by Neish (1973) to be 5 square nautical miles. It has never been commercially harvested. However, Neish (1973) found that "In the North American health food market prospects exist for the sale of kombu prepared from *Laminaria*....The quality of kombu made from Grand Manan wide frond *Laminaria* appeared to be satisfactory but was not premium grade....it was concluded that a product satisfactory for marketing...could be produced from plants harvested from the more exposed, silt-free areas of Grand Manan". "Kombu refers to kelp food products.

Small frond *Laminaria* is more restricted in distribution with the extent of the beds in the Grand Manan area estimated to be 0.1 square nautical miles (Neish, 1973). Neish has also indicated that "During the spring and summer these beds of small frond *Laminaria longicruris* yielded a higher grade of kombu which was worthy of exploitation.

If commercial markets could be established for the sale of *Laminaria*, Neish (1973), "assuming a conservative price of $1.50 per dry pound packaged", estimated that if fully exploited the harvesting of wide frond *Laminaria* could reach a gross value of close to $5,000,000 and that of small frond *Laminaria* could reach $507,000 if also fully exploited.

Marginally harvestable quantities of *Laminaria saccharina* were found in the southern areas of the Grand Manan Archipelago and it could occasionally be harvested along with wide frond *Laminaria* (Neish, 1973). Other species of *Laminaria* are found in small quantities throughout the study area but they either have no known commercial use or would be harvestable only to a small degree.

6. *Ascophyllum nodosum, Fucus spp.* (Rock weed). Both of these species of rockweed are abundant in the study area although no harvesting takes place. The development of a seaweed industry would create a fishery for these species since they can be used as a rockweed meal for fodder and human food.

7. *Alaria esculenta* (Kelp, ribbon kelp). *Alaria* is present in the study area but is not found in any great quantity. Although it can be powdered and used as a salt substitute or dried and eaten, there is no known market for *Alaria* at present.

8. *Enteromorpha, Ulva, and Monostroma (Green marine algae).* Although these species are abundant at certain localities in the study area no commercial harvesting takes place at present. They could be utilized as a garnish or seasoning as well as an ingredient in the Japanese dish "sushi".

9. *Agarum cribrosum* (Sea collander), *Desmarestia spp. Phycodrys rubens, Ptilota serrata.* Although *Ptilota* is not common in the study area, the other three species do commonly occur. None of these are harvested commercially as they are inedible to humans and have no known commercial use.

TABLE 9.4.1 AVAILABLE FISH LANDING STATISTICS FOR THE STUDY AREA IN LBS FROM: Caddy and Chandler, 1976; U.S. Environmental Protection Agency, 1976; Fisheries Statistics Branch, Environment Canada.

YEAR	S.S. CLAM	L OBSTER	SCALLOP	WINKLE	SHRIMP	HADDOCK	COD	POLLOCK
1947	0	611,000	10,000	0	0			
1948	0	771,000	18,000	0	0			
1949	197,000	666,000	16,000	0	0			
1950	514,000	747,000	94,000	0	0			
1951	896,000	917,000	81,000	0	0			
1952	644,000	834,000	190,700	0	0			
1953	290,000	993,000	90,100	10,000	0			
1954	482,200	825,000	13,900	0	0			
1955	252,700	901,000	31,600	0	0			
1956	341,000	818,000	83,600	0	0			
1957	122,918	740,479	44,240	0	0			
1958	0	855,980	8,016	0	0			
1959	15,349	575,108	200	0	0			
1960	0	685,563	6,200	1,400	0			
1961	0	564,601	4,050	0	0			
1962	0	518,046	9,300	0	0			
1963	0	685,451	10,700	0	0			
1964	0	631,530	1,900	0	0			
1965	0	603,683	17,225	2,200	0			
1966	11,624	619,640	2,200	0	5,632			
1967	0	489,283	200	19,110	224,000			
1968	0	617,132	32,550	17,500	239,575			
1969	0	944,039	1,249	42,015	31,952	60,815	513,877	449,886
1970	0	828,268	18,178	45,600	94,057	115,676	438,385	584,852
1971	30,000	795,747	3,700	52,150	250	661	109,674	71,844
1972	0	652,605	7,880	51,850	400	6,235	194,254	106,046
1973	0	677,656	10,677	71,300	0	28,294	265,929	516,000
1974	0	623,076	2,800	50,800	0	7,349	205,688	201,024
1975	0	708,369	1,600	59,961	0	249	100,072	179,867
1976								
1977								
1978								

(Numbers ending in 000 are probably rounded to nearest 000 lbs.

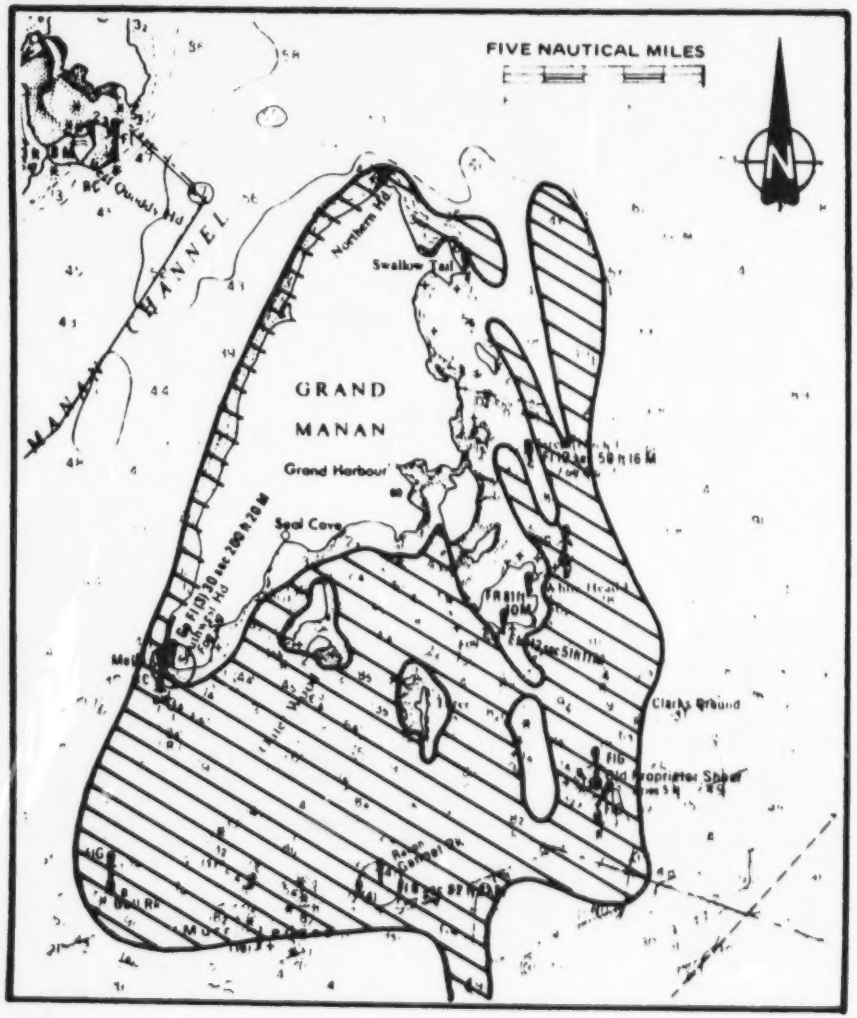
YEAR	HERRING	DULSE	HALIBUT	FLATFISH (unspec.)	HAKE (unspec.)	CUSK	CATFISH	MACKEREL
1947								
1948								
1949								
1950								
1951								
1952								
1953								
1954								
1955								
1956								
1957								
1958								
1959								
1960								
1961								
1962								
1963								
1964								
1965								
1966								
1967								
1968								
1969	30,345,127	66,893	4,228	3,862	2,757	161	3,840	0
1970	15,992,043	50,595	10,586	16,182	4,954	0	8,264	3,675
1971	10,798,021	66,449	9,222	375	868	0	1,054	18,375
1972	61,790,428	83,714	6,586	588	831	606	339	0
1973	39,789,602	52,202	1,635	?	365	0	4,217	19,600
1974	19,614,772	93,650	1,703	0	0	0	0	0
1975	32,812,007	102,074	412	0	0	0	0	960
1976								
1977								
1978								

BLANKS INDICATE NO DATA AVAILABLE

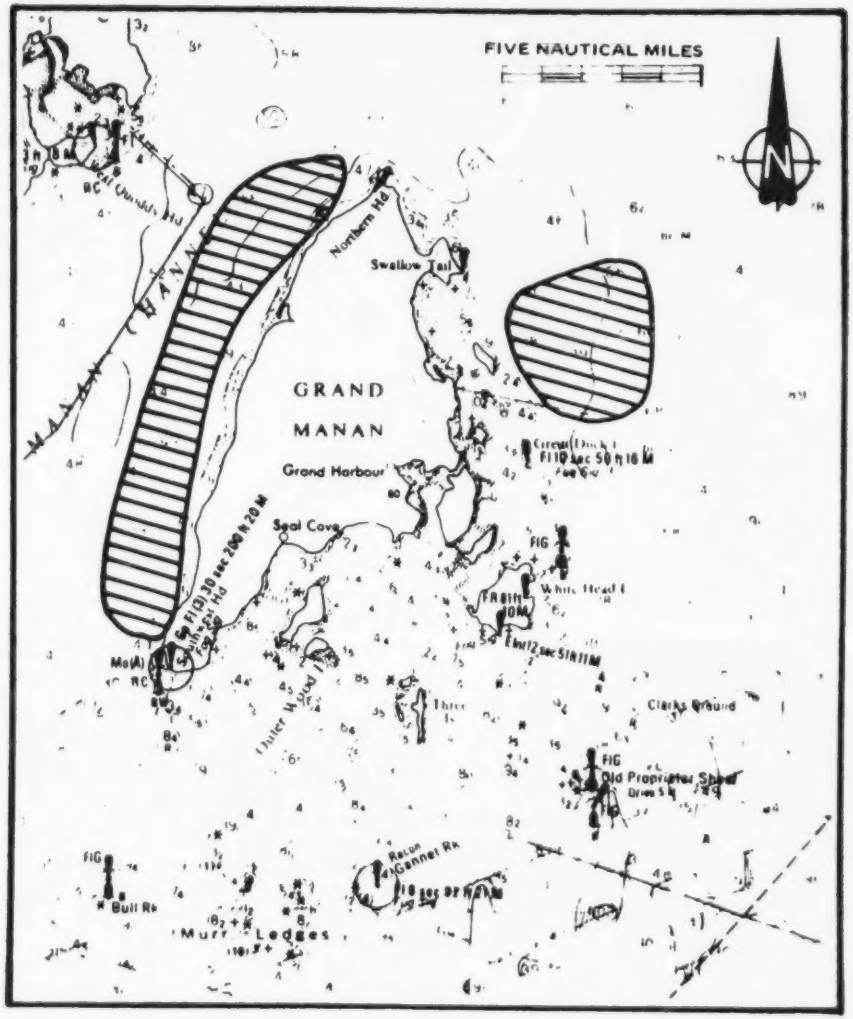
TABLE 9.4.2 The Grand Manan Weir Fishery, 1957-1962, (After "The New Brunswick Weir Fisheries for Juvenile Herring: A Preliminary Analysis of Catch Data for the Years 1957-1962", T.D. Iles, 1975) E - The Eastern side of Grand Manan Island. W - The Western side of Grand Manan Island.

YEAR	NUMBER OF WEIRS			YEARLY CATCH		CONTRIBUTION TO THE TOTAL N. B. WEIR FISHERY CATCH (east and west)
	Licensed	Licensed and Built	Caught fish during year	x 1000 lbs.		
1957	88E 3W	69E 2W	48E 1W	8890E	163W	15%
1958	79E 2W	58E 2W	40E 1W	3815E	32W	17%
1959	93E 6W	69E 3W	51E 3W	28,818E	1772W	43%
1960	94E 13W	60E 3W	43E 3W	21,278E	1087W	32%
1961	68W 4W	46E 3W	17E 2W	1,219E	130W	8%
1962	64E 12W	51E 4W	42E 4W	6840E	2108W	20%

9.3.1
LOBSTER FISHING AREAS THE GRAND MANAN ARCHIPELAGO

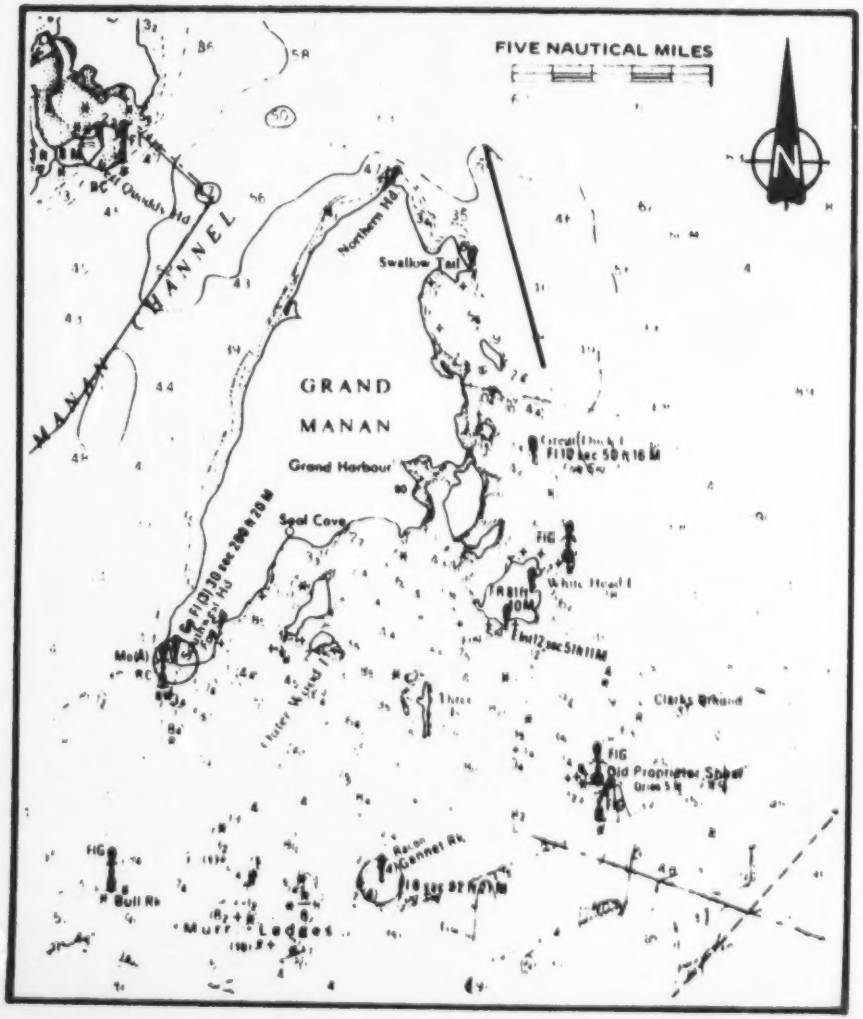


9.3.2
GROUNDFISHING AREAS
(Cod, Haddock, Pollock) THE GRAND MANAN ARCHIPELAGO



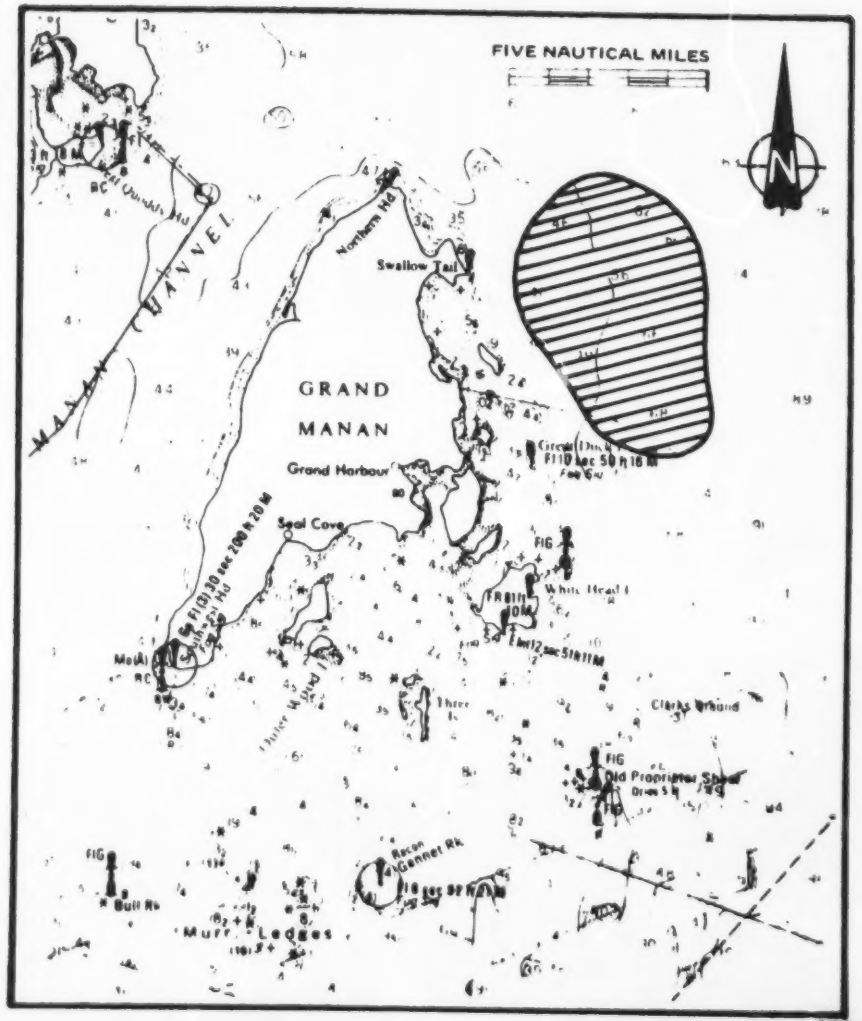
9.3.3
SQUID FISHING AREAS

THE GRAND MANAN ARCHIPELAGO



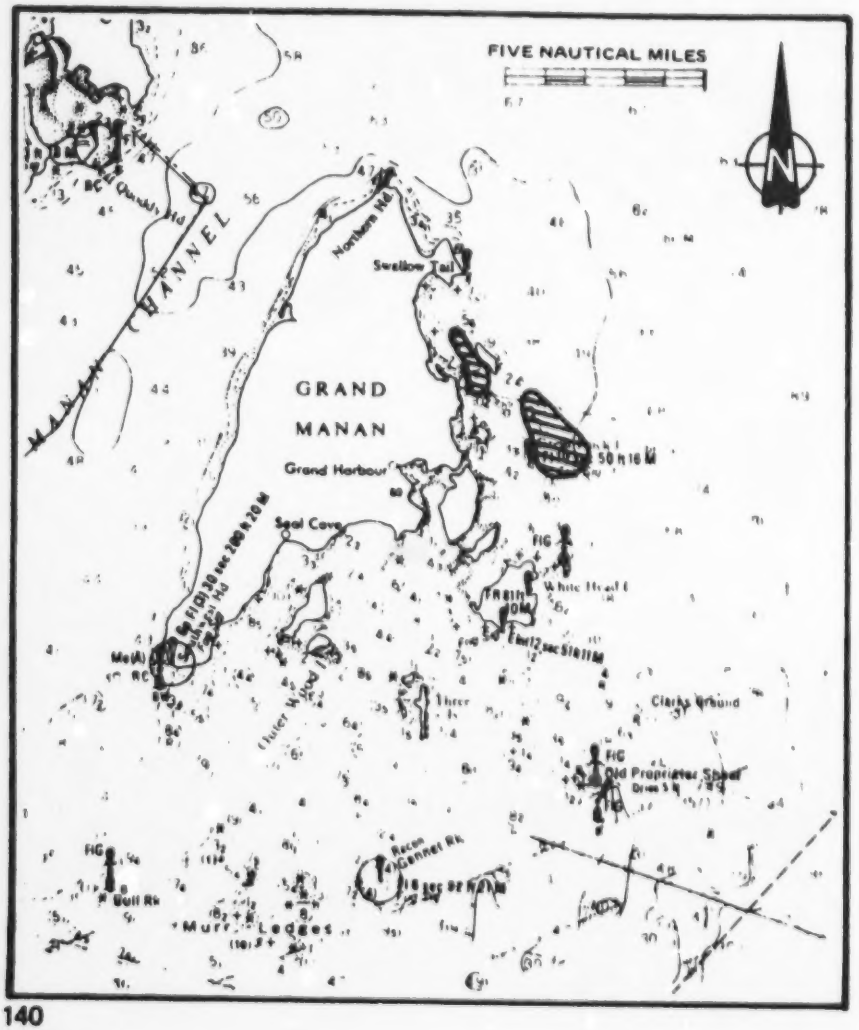
9.3.4
SHRIMP FISHING AREAS

THE GRAND MANAN ARCHIPELAGO



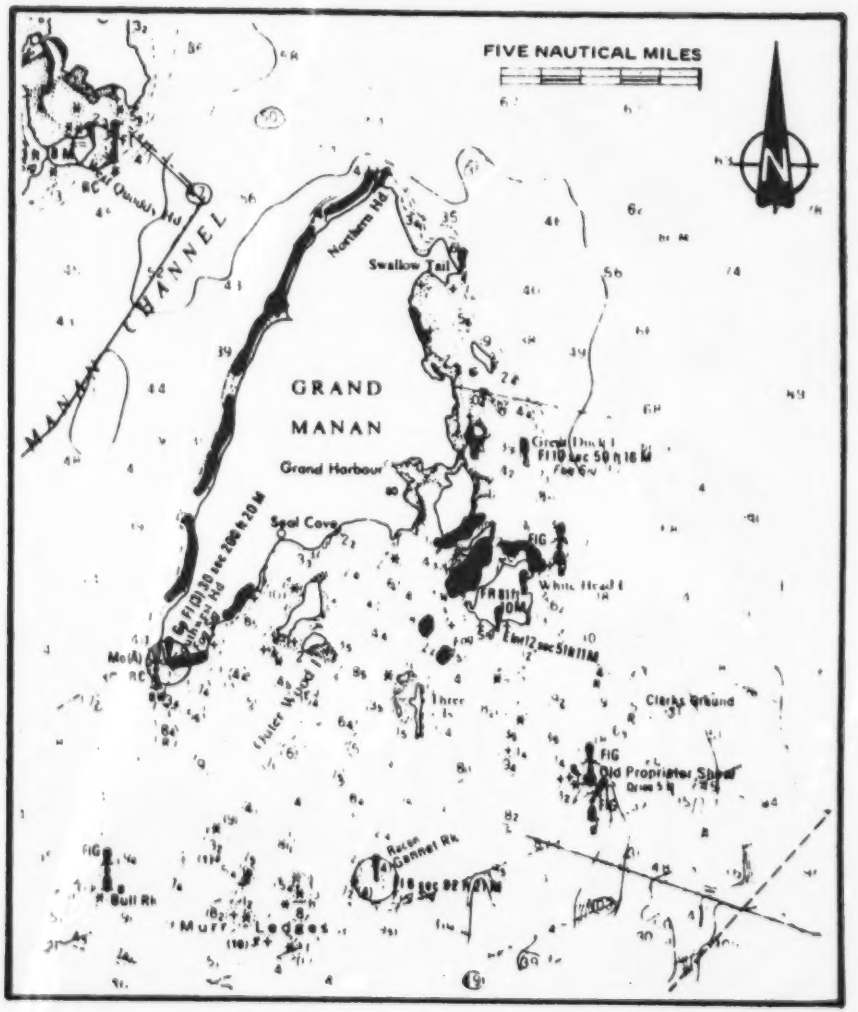
9.3.5
SCALLOP FISHING AREAS

THE GRAND MANAN ARCHIPELAGO



9.3.6
DULSE GROUNDS

THE GRAND MANAN ARCHIPELAGO



10. ACKNOWLEDGEMENTS

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